SOIL SURVEY OF

# Floyd County, Texas

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Texas Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1968-72. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1972. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Floyd County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

# HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in determining the suitability of tracts of land for farming, industry, and recreation.

## Locating Soils

All the soils of Floyd County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside, and a pointer shows where the symbol belongs.

## Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page number of the range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green; those that have a moderate limitation can be colored yellow; and those that have a severe limitation can be colored red.

*Farmers and those who work with farmers* can learn about use and management of the soils from the soil descriptions and from the discussion of the range sites.

*Game managers, sportsmen, and others* can find information about soils and wildlife in the section "Wildlife."

*Ranchers and others* can find, under "Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

*Community planners and others* can read about soil properties that affect the choice of sites for dwellings, for industrial buildings, and for recreation areas in the sections "Engineering Uses of the Soils" and "Recreational Development."

*Engineers and builders* can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

*Scientists and others* can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

*Newcomers in Floyd County* will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of the publication and in the section "General Nature of the County."

**Cover: Parallel benches constructed to help conserve water and prevent erosion. A diversion terrace on the left and grassed waterways in the foreground and on the right are used to protect the parallel benches. The soils are Pullman and Mansker clay loams.**

## Contents



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## Summary of Tables

# SOIL SURVEY OF FLOYD COUNTY, TEXAS

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

FLOYD COUNTY is mainly in the Southern High Plains area of Texas (fig. 1). The northeastern part is in the Rolling Red Plains area. Floyd County has a total area of 993 square miles, or 635,520 acres. Elevation ranges from approximately 2,400 feet in the northeastern corner to nearly 3,400 feet in the northwestern corner. The county is tilted to the southeast and has an average grade of about 10 feet per mile.

Floydada, the county seat, is in the south-central part of the county and has a population of about 4,500. The second largest city is Lockney, which has a population of about 2,400. Other communities located in the county are South Plains, Dougherty, Lake View, McCoy, Barwise, Sandhill, Aiken, Providence, Lone Star, and Cedar Hill.

The landscape consists mainly of a nearly level, almost featureless plain interrupted by numerous, closed depressions. The bottoms of depressions are playa lakes. Smooth plains in the northeastern part of the county are bordered by the Caprock and a dissected area of canyons and steep, vertical escarpments. A gently rolling plain is below the Caprock.

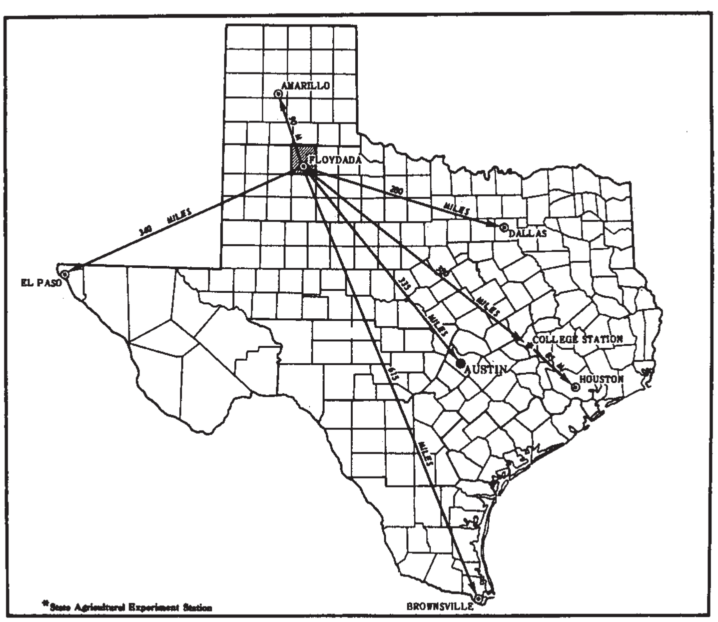


*Figure 1.*—**Location of Floyd County in Texas.**

Several small intermittent streams are in the county. Crawfish Creek flows through the southwestern part, and Los Linguish Creek flows through the extreme northeastern part. Running Water Draw enters the county on the west and becomes White River before it leaves the county in the south through Blanco Canyon. Quitaque Creek flows from the area near Lone Star and drains toward the southeast. Near South Plains, it meanders toward the northeast and leaves the county just south of Los Linguish Creek. In the extreme eastern part of the county is the head of Pease River. In the area just below the Caprock in the northeastern and eastern parts of the county, numerous small streams are fed by springs and flow year round.

Farming and ranching are the major enterprises in Floyd County. About 75 percent of the county is cultivated, and 25 percent is in native range. The main crops are grain sorghum, wheat, cotton, soybeans, and vegetables. Beef cattle ranching is the main livestock enterprise. Several feedlots are in the county, and thousands of beef cattle are fattened each year on locally grown grain.

About 300,000 acres in the county is irrigated. Irrigation is confined mostly to the High Plains part of the county, although a few wells are below the Caprock. In 1969, approximately 3,850 wells were in the county. Water is of good quality from most wells, but the water table is declining. Each year a few wells are abandoned. In the east-central part of the county there is either little water or not enough for large-scale irrigation.

## *How This Survey Was Made*

Soil scientists made this survey to learn what kinds of soil are in Floyd County, where they are located, and how they can be used. The soil scientists went into the county knowing they would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Amarillo and Olton, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Amarillo fine sandy loam, 0 to 1 percent slopes, is one of several phases within the Amarillo series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One kind of mapping unit shown on the soil map of Floyd County is the undifferentiated group.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils, joined by "and." Berda and Paloduro soils, 5 to 20 percent slopes, is an undifferentiated soil group in this county.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rock outcrop, which is mapped with Latom soils, is an example.

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

## General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Floyd County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is useful as a general guide in managing a watershed or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The six soil associations in Floyd County are dis-

cussed in the following pages. The terms for texture used in the descriptive headings for several of the associations apply to the surface layer. For example, in the title of association 5, the words "fine sandy loams" and "loams" refer to the texture of the surface layer.

### *1. Pullman association*

*Deep, nearly level to gently sloping, very slowly permeable clay loams*

The landscape of this association is a smooth plain that has many dish-shaped, closed depressions. Nearly all runoff is impounded in these depressions.

This association makes up about 73 percent of the county. It is about 82 percent Pullman soils and 18 percent Drake, Estacado, Lofton, Mansker, Olton, and Randall soils (fig. 2).

Pullman soils are in a continuous area that extends across the plain. These soils have a surface layer of brown clay loam. Below this is brown to reddish-brown clay that is very slowly permeable.

Drake soils are mainly on low, smooth dunes that encircle the deeper playas. Estacado, Mansker, and Olton soils are in positions similar to those of Pullman soils. Lofton soils are in slightly depressional areas that are mainly adjacent to playas, and Randall soils are on the bottom of playa lakes.

This association is used mostly for crops, but a few areas are in native range. Most cultivated areas are irrigated. The soils are well suited to surface irrigation because the surface is smooth. They are droughty in most places when dryfarmed. Low rainfall is a limitation in most years. The hazard of soil blowing is slight, and the hazard of erosion is slight to moderate.

### *2. Pullman-Olton association*

*Deep, nearly level to gently sloping, very slowly permeable to moderately slowly permeable clay loams*

This association is mostly a smooth plain that has many dish-shaped closed depressions. Nearly all runoff is impounded in these depressions.

This association makes up about 14 percent of the county. It is about 72 percent Pullman soils and about 12 percent Olton soils. The remaining 16 percent is Drake, Estacado, Lofton, Mansker, and Randall soils (fig. 3).

Pullman soils are on broad uplands and are in a continuous area that extends across the plain. These soils have a surface layer of brown clay loam. Below this is brown to reddish-brown clay that is very slowly permeable.

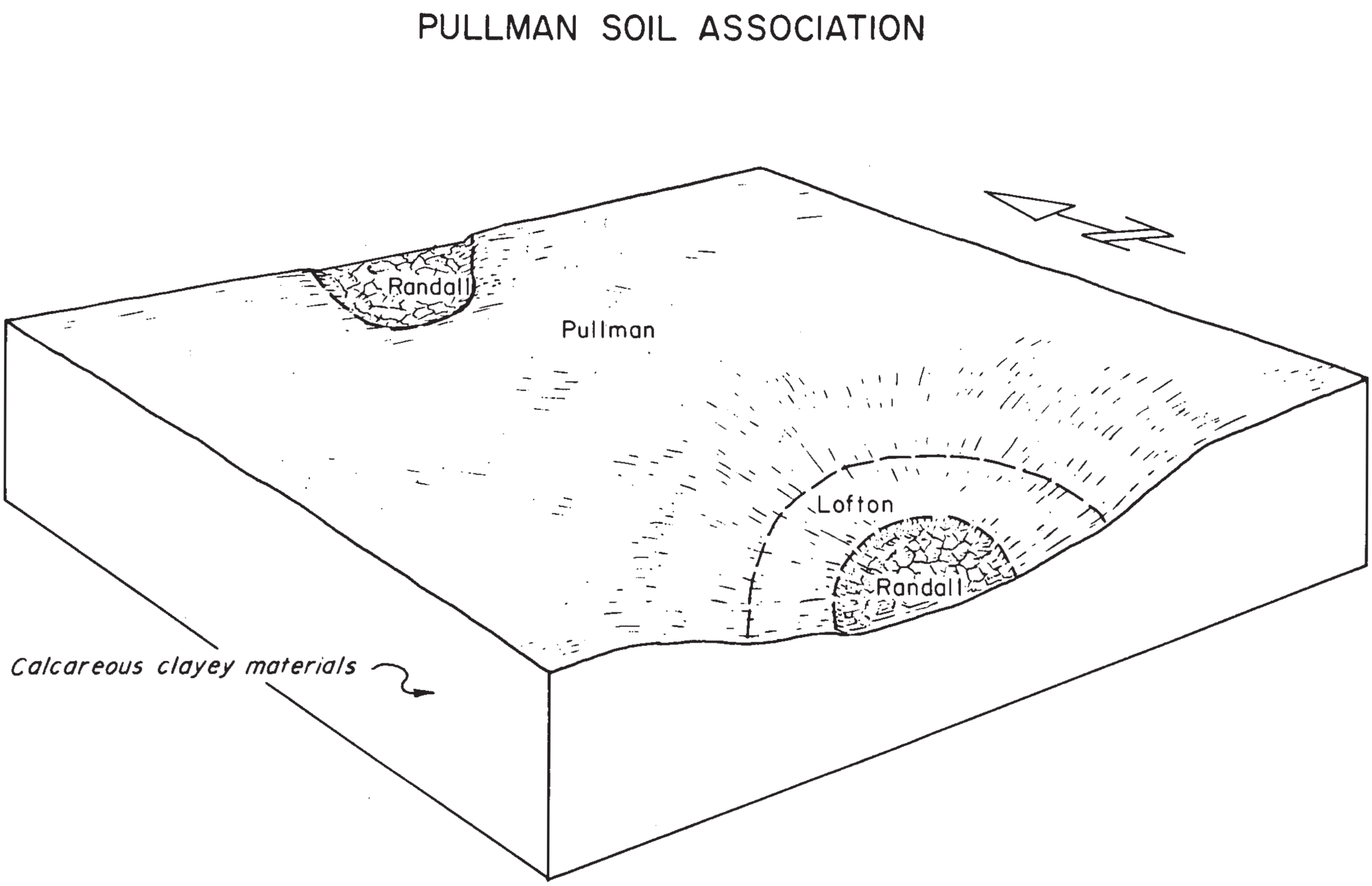


***Figure 2.*—Typical pattern of soils and underlying material in the Pullman association.**

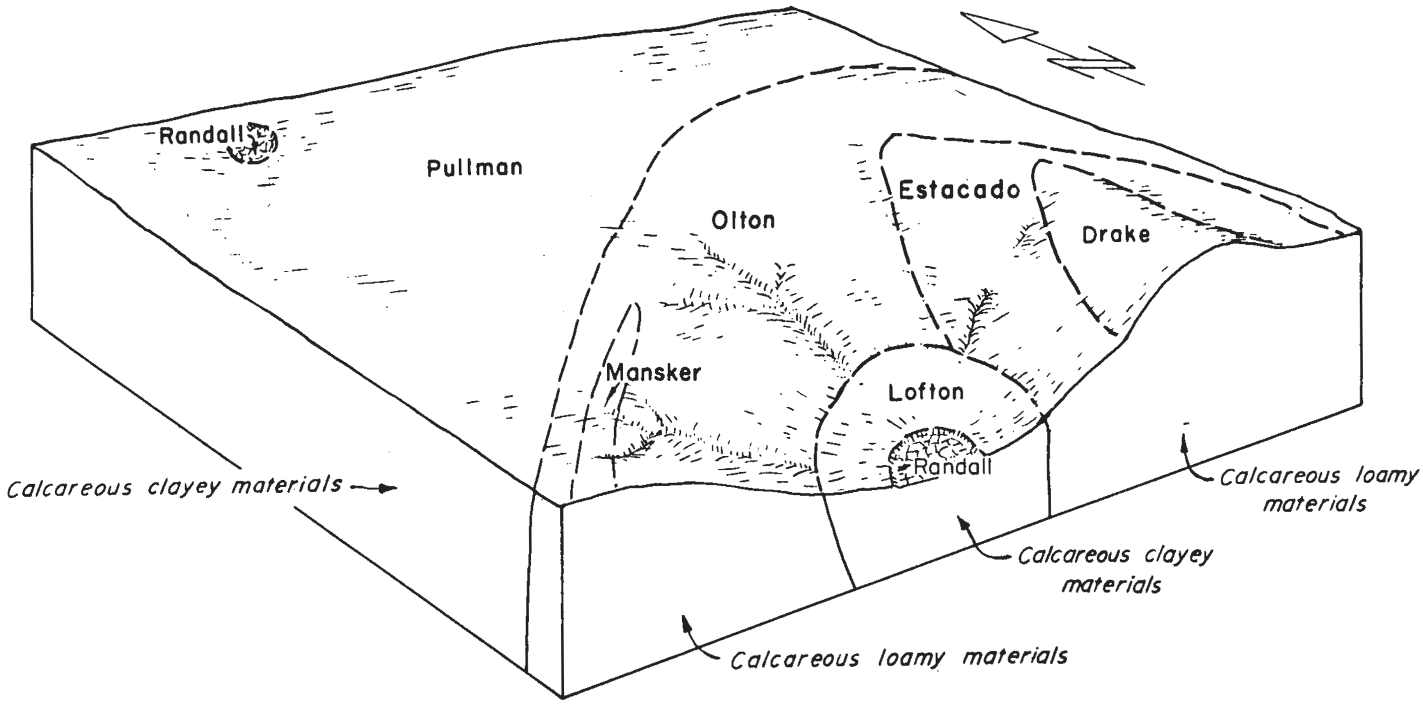


***Figure 3.*—Typical pattern of soils and underlying material in the Pullman-Olton association.**

Olton soils are on ridges and on side slopes around playa basins. These soils have a surface layer of reddish-brown clay loam. Below this is reddish-brown clay to clay loam that is moderately slowly permeable.

Drake soils are mostly on low, smooth dunes that encircle deep playas. Estacado and Mansker soils are in positions similar to those of Pullman soils. Lofton soils are in slightly depressional areas that are mainly adjacent to playas, and Randall soils are on the bottom of playa lakes.

This association is used mostly for crops, but a few areas are in native range. Most cultivated areas are irrigated. The nearly level soils are well suited to surface irrigation. The soils in this association are droughty in most places when dryfarmed, and low rainfall is a limitation in most years. The hazard of soil blowing is slight, and the hazard of erosion is slight to moderate.

### *3. Berda-Potter association*

*Deep to very shallow, gently sloping to steep, moderately permeable loams*

This association is mostly on rough, steep and broken terrain along the High Plains escarpment. It makes up about 5 percent of the county. Berda soils make up about 55 percent of the association and Potter soils about 7 percent. The remaining 38 percent is Bippus, Mansker, Mobeetie, and Paloduro soils.

Berda soils are on side slopes and on crests and knolls of small hills. These deep soils have a surface layer of brown loam over brown to light reddish-brown loam.

Potter soils are on side slopes of the Caprock Escarpment. These soils are shallow to very shallow and have a surface layer of brown loam over thick beds of caliche.

Bippus, Mansker, Mobeetie, and Paloduro soils are in the smoother areas.

This association is used mostly as range. Most of the soils are too steep or too shallow for farming, but they are suited to use as range and wildlife habitat. A few small areas of the smoother Berda soils are cultivated. The hazard of soil blowing is slight to moderate, and the hazard of erosion is moderate to severe. Some areas of this association are scenic.

### *4. Latom-Polar association*

*Very shallow to deep, gently sloping to moderately steep, moderately permeable and moderately rapidly permeable fine sandy loams to gravelly fine sandy loams*

This association is in rough, dissected areas on foot slopes below the Caprock escarpment. It is characterized by sandstone outcrops. The association makes up about 3 percent of the county. It is about 45 percent Latom soils and soils that are similar to Latom, except that they are less than 4 inches thick over sand-

stone. Polar soils make up about 9 percent, and the remaining 46 percent is Amarillo, Berda, Flomot, Lincoln, Obaro, Paloduro, and Quinlan soils.

Latom soils are in rough areas that give a "stair-step" appearance to the topography. These soils are shallow to very shallow. They have a surface layer of brown fine sandy loam that is moderately permeable. Below this is strongly cemented sandstone.

Polar soils are on the tops and sides of rounded hills. These deep soils have a surface layer of brown gravelly sandy loam. Below this is light-brown very gravelly sandy loam to loamy sand that is moderately rapidly permeable.

Amarillo, Berda, and Flomot soils are in smoother areas on hilltops and in dissected areas. Lincoln soils are in the larger drainageways that cross this association. Obaro and Quinlan soils are downslope from the areas of sandstone outcrop. Paloduro soils are in small valleys between the rounded hills.

This association is used mostly as range. Most of the soils are too steep or too shallow for farming, but they are suited to use as range and wildlife habitat. A few small tracts in smoother areas are cultivated. In some areas of Polar soils, gravel and sand are mined. The hazard of soil blowing is slight to moderate, and the hazard of erosion is moderate to severe. Some areas of this association are scenic.

### 5. *Amarillo-Berda association*

*Deep, nearly level to strongly sloping, moderately permeable fine sandy loams to loams*

This association is mainly on smooth plains dissected by a few creeks and rivers. It makes up about 3 percent of the county and is about 39 percent Amarillo soils and about 29 percent Berda soils. The remaining 32 percent is Flomot, Lincoln, Mobeetie, and Paloduro soils.

Amarillo soils are on broad upland plains and have a surface layer of reddish-brown fine sandy loam. Below this is reddish-brown, yellowish-red, or reddish-yellow sandy clay loam.

Berda soils are on broad foot slopes or on side slopes. These soils have a surface layer of brown loam over brown to light reddish-brown loam.

Flomot soils are on uplands near drainageways, and Lincoln soils are in areas near stream bottoms. Mobeetie soils are in positions similar to those of Berda and Paloduro soils. Paloduro soils are mostly in small valleys.

This association is used mostly for crops, but a few areas are in native range. The hazards of soil blowing and erosion are moderate to severe.

### 6. *Mansker-Bippus association*

*Deep, nearly level to gently sloping, moderately permeable clay loams*

This association is in valleys and on side slopes, mostly along drainageways. The topography is smooth and nearly level on the bottom of the valleys and gently sloping on the side slopes. The floor of the valleys is about 10 to 50 feet below the surrounding uplands.

This association makes up about 2 percent of the county. It is about 32 percent Mansker soils and about 26 percent Bippus soils. The remaining 42 percent is Berda, Estacado, Lofton, Olton, Paloduro, and Potter soils.

Mansker soils are mostly on side slopes that parallel drainageways. These soils have a surface layer of brown clay loam over light-brown to pink clay loam.

Bippus soils are on valley floors. These soils have a surface layer of grayish-brown clay loam over dark grayish-brown to brown clay loam.

Lofton soils are in slightly depressional areas. Berda, Estacado, Olton, Paloduro, and Potter soils are on side slopes and on uplands near drainageways.

This association is used mostly for crops, but a few areas are in range. Most cultivated areas are irrigated. The hazards of soil blowing and erosion are slight to severe.

## *Descriptions of the Soils*

In this section the soils of Floyd County are described in detail, and their use and management are discussed. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of each series description is the soil profile; that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, the differences are stated in the description of the mapping unit, or they are differences that are apparent in the name of the mapping unit. Soil colors in this section are expressed both in words and in Munsell color notations and are for dry soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Rock outcrop, for example, does not belong to a soil series; nevertheless, it is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and range site in which the mapping unit has been placed. The page for the description of each range site can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are given in table 1. Many of the terms used

in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*6*).[1]

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

| Soil | Acres | Percent |
|---|---|---|
| Amarillo fine sandy loam, 0 to 1 percent slopes | 2,400 | 0.4 |
| Amarillo fine sandy loam, 1 to 3 percent slopes | 3,500 | .6 |
| Amarillo fine sandy loam, 3 to 5 percent slopes | 2,340 | .4 |
| Berda loam, 1 to 3 percent slopes | 3,200 | .5 |
| Berda loam, 3 to 5 percent slopes | 3,240 | .5 |
| Berda loam, 5 to 12 percent slopes | 7,460 | 1.2 |
| Berda and Paloduro soils, 5 to 20 percent slopes | 10,300 | 1.6 |
| Berda and Potter soils, steep | 12,530 | 2.0 |
| Bippus clay loam, 0 to 1 percent slopes | 2,870 | .5 |
| Bippus clay loam, frequently flooded | 730 | .1 |
| Drake soils, 1 to 3 percent slopes | 470 | .1 |
| Drake soils, 3 to 5 percent slopes | 790 | .1 |
| Estacado clay loam, 0 to 1 percent slopes | 5,980 | .9 |
| Estacado clay loam, 1 to 3 percent slopes | 4,200 | .7 |
| Flomot fine sandy loam, 1 to 3 percent slopes | 730 | .1 |
| Flomot fine sandy loam, 3 to 5 percent slopes | 1,210 | .2 |
| Flomot fine sandy loam, 5 to 12 percent slopes | 510 | .1 |
| Latom soils and Rock outcrop, 5 to 20 percent slopes | 11,110 | 1.8 |
| Likes loamy fine sand, 3 to 8 percent slopes | 950 | .1 |
| Lincoln soils, frequently flooded | 1,080 | .2 |
| Lofton clay loam | 31,770 | 5.0 |
| Mansker clay loam, 1 to 3 percent slopes | 4,030 | .6 |
| Mansker clay loam, 3 to 5 percent slopes | 5,510 | .9 |
| Mobeetie fine sandy loam, 0 to 3 percent slopes | 590 | .1 |
| Obaro and Quinlan soils, 5 to 12 percent slopes | 1,200 | .2 |
| Olton clay loam, 0 to 1 percent slopes | 10,450 | 1.6 |
| Olton clay loam, 1 to 3 percent slopes | 10,830 | 1.7 |
| Paloduro loam, 0 to 1 percent slopes | 2,270 | .4 |
| Polar and Paloduro soils, 3 to 30 percent slopes | 2,860 | .4 |
| Portales loam, 0 to 1 percent slopes | 780 | .1 |
| Posey and Tulia soils, 5 to 12 percent slopes | 5,280 | .8 |
| Potter soils, 2 to 20 percent slopes | 530 | .1 |
| Pullman clay loam, 0 to 1 percent slopes | 422,300 | 66.4 |
| Pullman clay loam, 1 to 3 percent slopes | 23,850 | 3.7 |
| Randall clay | 37,190 | 5.8 |
| Springer loamy fine sand, 3 to 8 percent slopes | 480 | .1 |
| Total | 635,520 | 100.0 |

## Amarillo Series

The Amarillo series consists of deep, nearly level to gently sloping soils on uplands. These soils formed in loamy, calcareous, old, eolian or alluvial deposits.

In a representative profile the surface layer is reddish-brown fine sandy loam about 9 inches thick. The next layer to a depth of 40 inches is reddish-brown and yellowish-red, friable sandy clay loam that is calcareous in the lower part. Below this is 25 inches of reddish-yellow, friable sandy clay loam that is 30 percent calcium carbonate. The next layer to a depth of 84 inches is yellowish-red sandy clay loam that is about 10 percent calcium carbonate.

Amarillo soils are well drained. Runoff is slow to medium. Permeability is moderate, and available water capacity is high.

These soils are used mostly for cultivated crops. A few areas are irrigated. Areas in native vegetation are used as range.

Representative profile of Amarillo fine sandy loam, 1 to 3 percent slopes, 10.6 miles east and northeast of Cedar Hill on Farm Road 97 to its intersection with Farm Road 1065, then 3.1 miles north on Farm Road 1065, 0.2 mile east on a field road and 100 feet south of the road, in a cultivated field:

Ap—0 to 9 inches, reddish-brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; soft, friable; mildly alkaline; abrupt, smooth boundary.

B21t—9 to 18 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate, coarse, prismatic structure parting to weak, medium, subangular blocky; very hard, friable; many fine pores; few patchy clay films; common worm casts; mildly alkaline; gradual, smooth boundary.

B22t—18 to 24 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate, coarse, prismatic structure parting to weak, medium, subangular blocky; very hard, friable; many fine pores; few patchy clay films; common worm casts; mildly alkaline; gradual, smooth boundary.

B23t—24 to 40 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak, medium, subangular blocky structure; hard, friable; few fine pores; patchy clay films; few worm casts; common films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B24tca—40 to 65 inches, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak, medium, subangular blocky structure; hard, friable; 30 percent films, threads, soft masses, and few hard concretions of calcium carbonate; patchy clay films; calcareous; moderately alkaline; gradual, wavy boundary.

B25tca—65 to 84 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak, medium, subangular blocky structure; slightly hard, friable; patchy clay films; 10 percent films, threads, soft masses, and few hard concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon is 8 to 12 inches thick and is reddish brown or brown. It is neutral or mildly alkaline. The B2t horizon is mildly alkaline or moderately alkaline. The upper part of this horizon is reddish brown, brown, or yellowish red. The lower part has calcium carbonate, mainly as films and threads, but in some areas it has a few small concretions of calcium carbonate. The Btca horizon is at a depth of 30 to 56 inches and is pink, light reddish brown, and reddish yellow in the upper part. This upper part is 20 to 45 percent calcium carbonate, mainly soft powdery masses and concretions. The Btca horizon is red, reddish yellow, and yellowish red in the lower part. Carbonates in the lower part range from coatings on the faces of peds to concretions that make up 1 to 10 percent of the horizon.

**Amarillo fine sandy loam, 0 to 1 percent slopes (AfA).**—This nearly level soil is on uplands on smooth plains. Areas are irregular in shape and range from 10 acres to several hundred acres in size.

[1] Italic numbers in parentheses refer to Literature Cited, page 63.

The surface layer is reddish-brown fine sandy loam about 9 inches thick. The next layer extends to a depth of 70 inches. It is 16 inches of reddish-brown, friable sandy clay loam; 20 inches of yellowish-red, calcareous sandy clay loam; and 25 inches of reddish-yellow sandy clay loam that is about 25 percent calcium carbonate. Below this to a depth of 84 inches is yellowish-red sandy clay loam that is 10 percent calcium carbonate.

Included with this soil in mapping are small areas of Berda and Flomot soils and a few small areas of soils that have gravel on the surface. Also included are a few small areas of Amarillo fine sandy loam, 1 to 3 percent slopes. About 40 percent of Amarillo fine sandy loam, 0 to 1 percent slopes, has secondary carbonates below a depth of 34 inches.

This Amarillo soil is used mainly for crops, but a few areas are used as range. A few areas are irrigated. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are controlling soil blowing and erosion and conserving moisture. Runoff is slow. The hazards of soil blowing and erosion are moderate.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth, control soil blowing and erosion, and conserve moisture. An example of a suitable cropping system is 1 year of cotton followed by 2 years of grain sorghum, wheat, or some other high-residue crop. If the crop does not leave enough residue to control soil blowing, chiseling or listing are effective emergency measures. Varying the depth of plowing helps to prevent the formation of a plowpan.

This soil is well suited to sprinkler irrigation, but only a small acreage is irrigated. An irrigation system is needed that provides adequate water for crops and prevents soil and water losses. In some areas, using diversion terraces, terracing, and contour farming help to control erosion and conserve moisture. Capability unit IIIe–3, dryland, and IIe–2, irrigated; Sandy Loam range site.

**Amarillo fine sandy loam, 1 to 3 percent slopes (AfB).**—This gently sloping soil is on upland plains. Areas are irregular in shape and are 10 acres to several hundred acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are some areas of Amarillo soils that have slopes of less than 1 percent and areas of Amarillo soils that have slopes of more than 3 percent. Also included are a few areas of Berda, Flomot, and Olton soils and a few small areas of gravel outcrop. A few areas of soils that have a dark-colored surface layer and some areas of soils that have no layer of calcium carbonate accumulation are also included. Included areas make up less than 40 percent of the mapped area.

This Amarillo soil is used mostly for crops, but a few areas are used as range. A few small areas are irrigated. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are controlling soil blowing and erosion and conserving moisture. Runoff is slow to medium. The hazards of soil blowing and erosion are moderate.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth, control soil blowing and erosion, and conserve soil moisture. An example of a suitable cropping system is 1 year of cotton followed by 2 years of grain sorghum, wheat, or some other high-residue crop. If the crop does not leave enough residue to control soil blowing, chiseling or listing are effective emergency measures. Varying the depth of plowing helps to prevent the formation of a plowpan.

This soil is well suited to sprinkler irrigation, but only a small acreage is irrigated. An irrigation system is needed that provides adequate water for crops and prevents soil and water losses. Using diversion terraces, terracing, and contour farming help to control erosion and conserve moisture. Capability unit IIIe–3, dryland, and IIIe–3, irrigated; Sandy Loam range site.

**Amarillo fine sandy loam, 3 to 5 percent slopes (AfC).**—This gently sloping soil is on uplands. Areas are mostly longer than they are wide and follow the slope contours above drainage patterns. Some areas are on ridges or hilltops. Soil areas are 10 to 15 acres in size.

The surface layer is reddish-brown fine sandy loam about 8 inches thick. The next 13 inches is reddish-brown, friable sandy clay loam over 16 inches of yellowish-red, calcareous sandy clay loam. The next layer is about 28 inches of reddish-yellow sandy clay loam that is about 20 percent calcium carbonate. Below this to a depth of 80 inches is reddish-yellow sandy clay loam that is about 5 percent calcium carbonate.

Included with this soil in mapping are areas of Berda and Flomot soils and some areas of soils that are noncalcareous to a depth of more than 36 inches. Also included are a few areas of soils that have a dark-colored surface layer and some areas of soils that have no layers of calcium carbonate accumulation. A few areas of Amarillo soils that have slopes of more than 5 percent are also included. Gravel outcrops are in a few small areas.

This Amarillo soil is used mostly as range. It is not well suited to cultivation, but a few areas are used for crops. Grain sorghum and wheat are the main crops. The main concerns in management are controlling soil blowing and erosion and conserving moisture. Runoff is medium. The hazard of soil blowing is moderate, and the hazard of erosion is severe.

This soil can be cultivated, but special management and careful selection of crops are needed. Using crops in the cropping system that produce a large amount of crop residue and leaving the residue on the surface help to control soil blowing and erosion and conserve moisture. A suitable cropping system is growing mostly grain sorghums, small grains, or other high-residue crops. Cotton can be grown once every several years, but a mulch of cotton burs or other residue should be used, or a winter crop should be grown immediately following the cotton. If the crop does not leave enough residue, chiseling or listing are effective emergency measures.

This soil is suited to sprinkler irrigation. An irrigation system is needed that provides adequate water for crops and prevents soil and water losses. Terracing

and contour farming are needed to reduce runoff and control erosion. Diversion terraces and grassed waterways are needed in some areas. Capability unit IVe–2, dryland, and IVe–1, irrigated; Sandy Loam range site.

## Berda Series

The Berda series consists of deep, gently sloping to steep, loamy soils on uplands. These soils formed in loamy, calcareous colluvium.

In a representative profile the surface layer is brown, calcareous loam about 8 inches thick. The next layer is brown and light reddish-brown, friable, calcareous loam about 32 inches thick. The underlying material to a depth of 62 inches is light reddish-brown, calcareous loam that has a few films and threads of calcium carbonate.

Berda soils are well drained. Runoff is medium, and permeability is moderate. Available water capacity is high.

The soils in steeper areas are used as range. Some soils in less sloping areas are used for crops.

Representative profile of Berda loam, 5 to 12 percent slopes, 6.4 miles south on U.S. Highway 62 from its intersection with U.S. Highway 62 and 70 in Floydada, and 250 feet east of the highway, in range:

A1—0 to 8 inches, brown (7.5YR 5/2) loam, dark brown (7.5YR 4/2) moist; weak, coarse, prismatic structure parting to moderate, fine, granular; slightly hard, friable; many roots; few concretions of calcium carbonate; many worm casts; calcareous; moderately alkaline; clear, smooth boundary.

B2—8 to 26 inches, brown (7.5YR 5/4) loam, brown (7.5YR 4/4) moist; weak, coarse, prismatic structure parting to weak, subangular blocky and moderate, fine, granular; slightly hard, friable; few roots; few pores; many worm casts; films, threads, and few small concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B2ca—26 to 40 inches, light reddish-brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; weak, coarse, prismatic structure and weak, medium, subangular blocky structure; slightly hard, friable; few fine roots in upper part; 5 percent powdery masses and few strongly and weakly cemented concretions and fragments of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

C—40 to 62 inches, light reddish-brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; weak, coarse, prismatic structure and weak, medium, subangular blocky structure; slightly hard, friable; few fine pores; few films, threads, and fragments of calcium carbonate; calcareous; moderately alkaline.

The A1 horizon is 6 to 14 inches thick and is reddish brown to brown and grayish brown. It is mainly loam but ranges to fine sandy loam, gravelly clay loam, and clay loam. The B2 horizon and the B2ca horizon are reddish-brown, light reddish-brown, light-brown, and brown loam, sandy clay loam, or clay loam. The B2ca horizon ranges from a few films and threads of calcium carbonate, to about 10 percent, by volume. The C horizon is light reddish-brown, reddish-brown, light-brown, or brown fine sandy loam, loam, sandy clay loam, or clay loam.

**Berda loam, 1 to 3 percent slopes** (BeB).—This gently sloping soil is on uplands, on broad plains and side slopes. Areas range from a few acres in size to as large as 200 acres.

The surface layer is reddish-brown, calcareous loam about 8 inches thick. The next layer is about 10 inches of reddish-brown, friable, calcareous loam that has a few films and threads of calcium carbonate. Below this is about 20 inches of reddish-brown, friable, calcareous loam that is about 3 percent films, threads, and small concretions of calcium carbonate. The underlying material is reddish-brown, calcareous loam that extends to a depth of 60 inches.

Included with this soil in mapping are some areas of Amarillo, Bippus, Flomot, Mobeetie, and Paloduro soils. Also included are areas of a soil that is similar to Berda soil but is redder in color. Some areas of soils that are eroded and have small gullies which are difficult to cross with farm machinery are also included.

This Berda soil is used mostly for crops, but a few areas are used as range. A few small areas are irrigated. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are controlling soil blowing and erosion and conserving moisture. Runoff is medium. The hazards of soil blowing and erosion are moderate.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth, control soil blowing and erosion, and conserve moisture. An example of a suitable cropping system is cotton or some other row crop followed by grain sorghum, wheat, or some other high-residue crop. If the crop does not leave enough residue to control soil blowing, chiseling or listing are effective emergency measures. Applying a mulch of cotton burs or other residue or growing a cover crop also help to control soil blowing.

In areas where this soil is irrigated, a properly designed surface or sprinkler irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces, terracing, and contour farming help to control erosion and conserve moisture. In some areas where a surface irrigation system is used, land leveling may be needed. Capability unit IIIe–2, dryland, and IIIe–2, irrigated; Hardland Slopes range site.

**Berda loam, 3 to 5 percent slopes** (BeC).—This gently sloping soil is mostly in areas that border drainageways. Most areas are irregular in shape and are 10 to 100 acres in size. Slopes average about 4 percent.

The surface layer is brown, calcareous loam about 7 inches thick. The next layer is about 13 inches of brown, friable, calcareous loam that has many worm casts. Below this is about 30 inches of light-brown, friable, calcareous loam that is about 3 percent calcium carbonate. The underlying material to a depth of 70 inches is light reddish-brown, friable, calcareous loam that has a few films and threads of calcium carbonate.

Included with this soil in mapping are areas of Amarillo, Flomot, Mobeetie, and Paloduro soils. Also included are areas of a soil that is similar to Berda soil but is redder in color. Some areas of soils that are eroded and have gullies which cannot be crossed by farm machinery are also included.

This Berda soil is used mostly as range. It is not well suited to cultivation, but some areas are dryfarmed. Grain sorghum and wheat are the main crops. The main concerns in management are controlling soil

blowing and erosion and conserving moisture. Runoff is medium to rapid. The hazard of soil blowing is moderate, and the hazard of erosion is severe.

This soil can be cultivated, but special management and careful selection of crops are needed. Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth, control soil blowing and erosion, and conserve moisture. An example of a suitable cropping system is grain sorghum, wheat, or some other high-residue crop grown each year. If the crop does not leave enough residue to control soil blowing, chiseling or listing are effective emergency measures.

In areas where this soil is irrigated, a properly designed sprinkler irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces and grassed waterways, terracing, and contour farming help to control erosion. Capability unit IVe-3, dryland, and IVe-2, irrigated; Hardland Slopes range site.

**Berda loam, 5 to 12 percent slopes** (BeD).—This sloping to strongly sloping soil is mostly close to drainageways and near foot slopes on the High Plains Escarpment. Areas are irregular in shape and are 20 acres to nearly 200 acres in size. Slopes average about 7 percent. Deep gullies that cannot be crossed by farm machinery dissect some areas. This soil has the profile described as representative of the series.

Included with this soil in mapping are some areas of Bippus, Flomot, Mobeetie, and Paloduro soils. Also included are some areas of soils that have slopes of more than 12 percent and areas of soils near the Escarpment that have large gravel and rock fragments of calcium carbonate. A soil that is similar to Berda soil but is redder in color is also included in some areas.

This Berda soil is used as range. The main concerns in management are controlling erosion and conserving moisture. Runoff is medium to rapid. The hazard of soil blowing is moderate, and the hazard of erosion is severe.

Maintaining a minimum of 50 percent of a season's growth of grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass help to control soil blowing and erosion. Controlling brush by chemical or mechanical methods helps to prevent unnecessary moisture loss. A brush-control program should allow for planned areas of wildlife habitat. Capability unit VIe-2, dryland; Hardland Slopes range site.

**Berda and Paloduro soils, 5 to 20 percent slopes** (BoE).—This mapping unit is about 62 percent Berda soil, 19 percent Paloduro soil, and 19 percent other soils. These sloping to moderately steep soils are immediately below the High Plains Escarpment. They are mainly in one large, continuous, irregularly shaped area that is several hundred feet wide to nearly a mile wide in places and is about 25 miles long. Small drainageways, several hundred feet apart, dissect most areas. Exposures of the Ogallala Formation are on the top of small hills and on the bottom of drainageways. Deep gullies are in some depressions.

The composition of this unit is variable. The Berda soil is dominant and is in all areas. The Paloduro soil is less extensive, but it also is in all areas. The soils are so intermingled that it is not practical to separate them at the scale used in mapping.

The Berda soil is mainly near the crest of knolls and on the convex sides of small hills. It has a surface layer of brown, calcareous loam about 6 inches thick. The next layer is brown, friable, calcareous loam about 18 inches thick that has many worm casts. Below this is about 29 inches of light reddish-brown, friable, calcareous loam that is about 5 percent calcium carbonate. The underlying material to a depth of 62 inches is light reddish-brown, friable, calcareous loam that has a few films and threads of calcium carbonate.

The Paloduro soil is on side slopes, in drainageways, and in depressions between knolls. It has a surface layer of brown, calcareous loam about 12 inches thick. The next layer is about 10 inches of brown, friable, calcareous sandy clay loam that has many worm casts. Below this to a depth of 63 inches is light-brown, friable, calcareous sandy clay loam that is 10 percent calcium carbonate.

Included with these soils in mapping are areas of Bippus, Flomot, Mobeetie, Polar, and Potter soils and areas of badland. The badlands are on the top of knolls and in gullied areas and consist of barren exposures of the Ogallala Formation. Most exposures are sandy loam to clay loam and are slightly cemented because the content of calcium carbonate is high. The soil in these areas is mainly a mantle of colluvium that is less than 3 inches thick. Also included are areas of Berda and Paloduro soils that have a layer of calcium carbonate accumulation and other areas of these soils that are more than 35 percent rock fragments.

These soils are used only as range. The main concerns in management are controlling erosion and conserving moisture. Runoff is medium to rapid. The hazard of soil blowing is moderate, and the hazard of erosion is severe.

Maintaining a minimum of 50 percent of a season's growth of grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass help to control soil blowing and erosion. Controlling brush by chemical or mechanical methods helps to conserve moisture. A brush-control program should allow for planned areas of wildlife habitat. Capability unit VIe-2, dryland; Hardland Slopes range site.

**Berda and Potter soils, steep** (BPG) —This mapping unit is about 35 percent Berda soils, 15 percent Potter soils, 31 percent a soil that is similar to Berda soils but is shallower to the underlying material, 5 percent Mobeetie soils, and 14 percent other soils. These steep soils are along and include the eastern margin of the High Plains Escarpment (fig. 4). They are mainly on rough terrain in one large, continuous, irregularly shaped area that is several hundred feet to one-half mile across and about 25 miles long. A rim or cap of indurated caliche which is the top of the Ogallala Formation is in higher areas of the mapping unit. Slopes are 20 to 40 percent in the area immediately below the Caprock, but most slopes are 30 percent. Sheer bluffs 5 to 50 feet high are in some areas. The difference in elevation in some areas is 200 feet in less

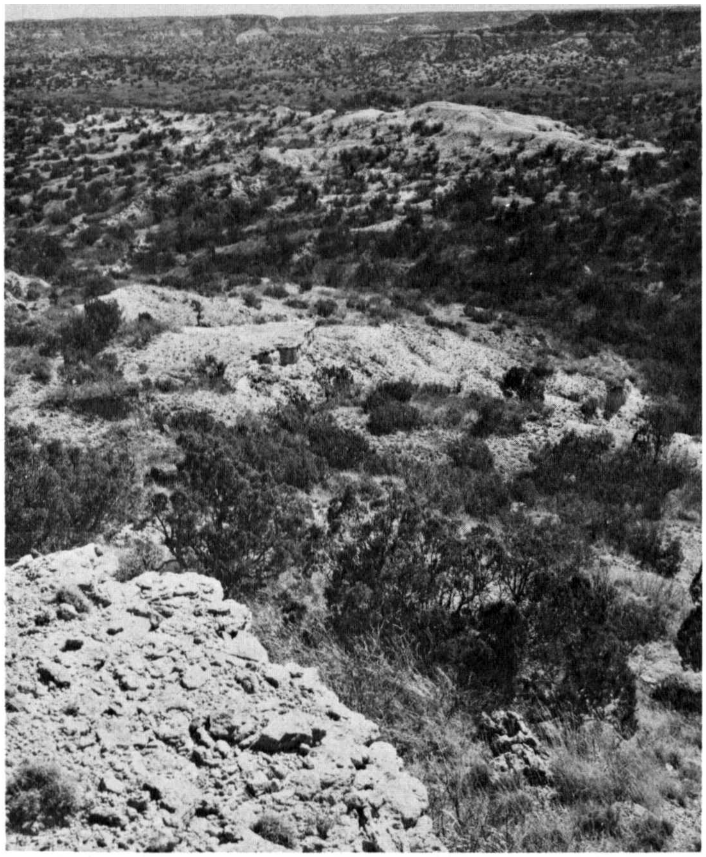

*Figure 4.*—**Area of Berda and Potter soils, steep.**

than one-fourth mile. In other areas the elevation difference is 300 feet in one-half mile.

The soils are not in a uniform pattern. Areas of this mapping unit are much larger and their composition is more variable than those of most other mapping units in the county. In some areas the soils are different within a few feet, but in other areas the soils are the same in areas as long as 300 feet. Most soil differences are in the depth of the surface layer, the amount of cobbles in the surface layer, and the depth to the caliche layer. Mapping has been controlled well enough, however, for the anticipated use of the soils.

The Berda soil is in irregularly shaped areas on steep side slopes. It has a surface layer of brown, calcareous gravelly clay loam about 8 inches thick. Below this is about 20 inches of brown, calcareous clay loam that is about 10 percent calcium carbonate. The next layer is light reddish-brown, calcareous clay loam about 24 inches thick. The underlying material is reddish-brown, calcareous clay loam that extends to a depth of 60 inches.

The Potter soils are mainly along the rim of the Caprock and on ledges of steep side slopes. They have a surface layer of brown, calcareous loam about 5 inches thick. The underlying material is white caliche.

Included with these soils in mapping are areas of Flomot and Mansker soils and areas of badlands. The badlands are barren exposures of the Ogallala Formation and are mostly sandy loam to clay loam and are slightly cemented because the content of calcium carbonate is high. The soil material is removed as fast as it forms and is usually barren of any vegetation. Also included are areas of Berda soil that are more than 35 percent caliche rock and some caliche outcrop in areas of Potter soils. Areas of soils that are similar to Bippus and Paloduro soils but are more than 35 percent caliche rock are also included. Paloduro soils are intermingled with the Berda soil and formed in areas where runoff concentrates and organic matter has darkened the surface.

These soils are used as range and wildlife habitat. A few small areas are inaccessible to livestock, but wildlife live in these areas. The main concerns in management are controlling erosion and conserving moisture. Runoff is medium to very rapid. The hazard of soil blowing is moderate, and the hazard of erosion is severe.

Maintaining a minimum of 50 percent of a season's growth of grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass help to control soil blowing and erosion and conserve moisture. Capability unit VIIe–1, dryland; Rough Breaks range site.

## Bippus Series

The Bippus series consists of deep, nearly level, loamy soils in concave areas on uplands. These soils formed in loamy calcareous material along major draws.

In a representative profile the surface layer is grayish-brown and dark grayish-brown, calcareous clay loam about 28 inches thick. The next layer is brown, very friable, calcareous clay loam and sandy clay loam that extends to a depth of 66 inches.

Bippus soils are well drained. Runoff is medium to rapid, and permeability is moderate. Available water capacity is very high.

These soils are used mostly for crops. They are well suited to dryland and irrigated farming. Many areas are irrigated. Some areas are subject to flooding. Areas in native vegetation are used as range.

Representative profile of Bippus clay loam, 0 to 1 percent slopes, 10 miles west on Farm Road 784 from its intersection with U.S. Highway 70 in Floydada, then 4.4 miles north on a county road and 200 feet north, then 100 feet west of the road, in a field:

Ap—0 to 15 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine and medium, granular structure; slightly hard, very friable; calcareous; moderately alkaline; abrupt, smooth boundary.

A1—15 to 28 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; slightly hard, very friable; few fine roots; many fine pores; many worm casts; calcareous; moderately alkaline; gradual, smooth boundary.

B21b—28 to 50 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; weak, medium, subangular blocky structure; slightly hard, very friable; few worm casts; few films and threads of calcium

carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B22b—50 to 66 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak, medium, subangular blocky structure; slightly hard, very friable; few films and threads of calcium carbonate; calcareous; moderately alkaline.

The A horizon is 16 to 28 inches thick and is dark brown, dark grayish brown, or grayish brown. The B2b horizon is reddish-brown, brown, dark-brown, or dark grayish-brown loam, sandy clay loam, or clay loam. Calcium carbonate content ranges from visible films and threads to as much as 10 percent, by volume. In some places weak stratification is evident in lower layers.

**Bippus clay loam, 0 to 1 percent slopes** (BtA).—This nearly level soil is in narrow, elongated areas that are as large as several hundred acres in size. Slopes average less than 0.5 percent. A deep channel less than 25 feet across winds throughout many areas, but it is not in some areas because waterways have been constructed. This soil has the profile described as representative of the series.

Included with this soil in mapping are some areas of Berda, Estacado, Mansker, Mobeetie, and Paloduro soils. Also included are areas of soil that is similar to Bippus soil but has bedding planes and thin strata of coarser and finer material. Areas of soils that have surface layers of loamy fine sand or fine sandy loam are also included.

This Bippus soil is used mostly for crops. Most cultivated areas are irrigated, but a few areas are dryfarmed. Cotton, grain sorghum, soybeans, and wheat are the main crops. The main concerns in management are controlling erosion and conserving moisture. Runoff is medium. The hazards of soil blowing and erosion are slight.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth, control soil blowing and erosion, and conserve moisture. An example of a suitable cropping system is cotton followed by grain sorghum, wheat, or some other high-residue crop every other year. If the crop does not leave enough residue to control soil blowing, chiseling or listing are effective emergency measures.

This soil is suited to surface or sprinkler irrigation. A properly designed irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces and grassed waterways, contour farming, and land leveling where needed help to control erosion and conserve moisture. Capability unit IIe–1, dryland, and IIe–1, irrigated; Valley range site.

**Bippus clay loam, frequently flooded** (Bw).—This nearly level soil is on flood plains mostly in Blanco Canyon along the White River in the southern part of the county. Areas are narrow in shape and are in an almost continuous band. A winding channel that is about 5 to 10 feet deep and about 15 to 50 feet wide dissects the soil area. Slopes are 0 to 1 percent.

The surface layer is about 6 inches of dark-brown clay loam that has many thin strata of material that is lighter and darker in color than the surface material. The next layer is dark grayish-brown and brown, friable clay loam about 40 inches thick. Below this is brown sandy clay loam that extends to a depth of 75 inches.

Included with this soil in mapping are some areas of Berda, Mansker, and Mobeetie soils.

This Bippus soil is used as range. It is subject to flooding one or more times a year about every 2 years. During periods of excessive rainfall the soil is flooded several days at a time. The main concerns in management are controlling erosion and conserving moisture. Runoff is medium to rapid. The hazards of soil blowing and erosion are slight.

Maintaining a minimum of 50 percent of a season's growth of grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass help to control soil blowing and erosion. Controlling brush by chemical or mechanical methods helps to conserve moisture. A brush-control program should allow for planned areas of wildlife habitat. Capability unit Vw–1, dryland; Valley range site.

## Drake Series

The Drake series consists of deep, gently sloping, loamy soils on uplands. These soils are on low, smooth dunes that practically encircle many of the deeper playa depressions. They formed in deposits 4 to 15 feet thick of calcareous eolian material on the eastern and southern side of playa depressions.

In a representative profile the surface layer is grayish-brown, calcareous loam about 7 inches thick. The underlying material is light brownish-gray and light-gray, calcareous clay loam that extends to a depth of 60 inches.

Drake soils are well drained. Runoff is rapid, and permeability is moderate. Available water capacity is medium.

About half of the acreage of these soils is cultivated. A few areas are irrigated. Areas in native vegetation are used as range. In cultivated areas the high lime content in the soils causes plant chlorosis.

Representative profile of Drake loam in an area of Drake soils, 3 to 5 percent slopes, 6 miles north on Farm Road 2301 from its intersection with U.S. Highway 70 in Aiken, then 0.75 mile east on a county road and 200 feet north of the road, in range:

A1—0 to 7 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, medium, granular structure; slightly hard, friable; few fine roots; few pores; few worm casts; calcareous; moderately alkaline; clear, smooth boundary.

C1—7 to 16 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; massive; hard, friable; few fine roots; few fine pores; common worm casts; calcareous; moderately alkaline; gradual, smooth boundary.

C2—16 to 60 inches, light-gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) moist; massive; few, weak, vertical cleavage planes; hard, friable; few fine roots in upper part; calcareous; moderately alkaline.

The A1 horizon is 5 to 10 inches thick. It is grayish-brown or brown fine sandy loam and loam to clay loam. The C1 horizon is 6 to 24 inches thick. It is light brownish-gray, pale-brown, or very pale brown loam to sandy clay loam and clay loam. The C2 horizon is at a depth of 12 to 34 inches. It is gray, light-gray, or very pale brown sandy clay

loam to clay loam. In a few places this horizon has films, threads, and soft masses of visible segregated calcium carbonate.

**Drake soils, 1 to 3 percent slopes** (DrB).—These gently sloping soils are in scattered areas of the county. Areas are mostly long and narrow and are on the eastern and southern sides of playa lakebeds. Slopes are mostly 2 to 3 percent. These soils are mainly in convex, duned areas that are 1 foot to 15 feet higher than the surrounding upland plain.

The surface layer is brown, calcareous clay loam about 5 inches thick. The next layer is pale-brown, friable, calcareous clay loam about 8 inches thick. Below this is about 16 inches of very pale brown, friable, calcareous clay loam that is about 3 percent visible calcium carbonate in the form of films, threads, and soft masses. The underlying material is very pale brown, friable, calcareous clay loam that extends to a depth of 60 inches.

Included with these soils in mapping are small areas of Estacado, Mansker, and Portales soils. Also included are small areas of Drake soils, 3 to 5 percent slopes. Included areas are mostly less than 5 acres in size.

These Drake soils are mostly cultivated, and some areas are irrigated. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are controlling erosion, maintaining soil productivity, and using cropping systems that overcome soil limitations. Runoff is rapid. The hazard of soil blowing is severe, and the hazard of erosion is moderate. The lime in the surface layer and in the lower layers keeps some of the plant nutrients in an unavailable form, and crop yields are lowered.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth and productivity, control soil blowing and erosion, and conserve moisture. An example of a suitable cropping system is grain sorghum, wheat, or other high-residue crop grown each year. If the crop does not leave enough residue to control soil blowing, listing or chiseling are effective emergency measures. The use of fertilizer and some trace elements helps to overcome plant nutrient deficiencies.

These soils are suited to sprinkler irrigation. A properly designed irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces, grassed waterways, land leveling, and contour farming help to control erosion and conserve moisture. Capability unit IVe–5, dryland, and IIIe–5, irrigated; High Lime range site.

**Drake soils, 3 to 5 percent slopes** (DrC).—These gently sloping soils are in scattered areas of the county. Most areas are long and narrow in shape and form narrow bands along the eastern and southern sides of playa lake basins. The areas are mainly on the highest point of the convex dune and extend down into the basin of the lake. A soil in this unit has the profile described as representative of the series.

Included with these soils in mapping are some areas of soils that are fine sandy loam throughout the profile and areas of soils that have a clay content of less than 18 percent. Also included are small areas of Estacado, Mansker, and Portales soils.

These Drake soils are used mostly as range, but a few areas are cultivated. A few cultivated areas are irrigated. Grain sorghum and wheat are the main crops. The soils are best suited to use as range. The main concerns in management are controlling soil blowing and erosion and conserving moisture. Runoff is rapid. The hazard of soil blowing is severe, and the hazard of erosion is moderate. The lime in the surface layer and in the lower layers keeps some of the plant nutrients in unavailable form.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to control soil blowing and erosion. In areas where these soils are irrigated, a properly designed sprinkler irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Reseeding formerly cultivated land to native grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass helps to control soil blowing and erosion. Capability unit VIe–3, dryland, and IIIe–5, irrigated; High Lime range site.

## Estacado Series

The Estacado series consists of deep, nearly level to gently sloping, loamy soils on uplands. These soils formed in loamy, calcareous, eolian material.

In a representative profile the surface layer is grayish-brown, calcareous clay loam about 15 inches thick. The next layer is brown and reddish-yellow, friable clay loam about 30 inches thick. It has many films and threads of calcium carbonate in the upper part and is about 35 percent calcium carbonate in the lower part. The next layer is about 25 inches of reddish-yellow clay loam that is about 20 percent calcium carbonate. Below this is red silty clay loam that is about 5 percent calcium carbonate and extends to a depth of 82 inches.

Estacado soils are well drained. Runoff is slow, and permeability is moderate. Available water capacity is high. In some places free lime in the surface layer causes a deficiency of plant nutrients in some crops.

These soils are used mostly for dryland and irrigated crops. A few areas are in native vegetation and are used as range.

Representative profile of Estacado clay loam, 0 to 1 percent slopes, 1 mile north of South Plains on Texas Highway 207, then 3 miles east on a county road, then 0.35 mile north and 0.25 mile east on the same county road, then 150 feet north of the road, in a cultivated field:

Ap—0 to 15 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; slightly hard, friable; few slightly cemented concretions of calcium carbonate; calcareous; moderately alkaline; abrupt, smooth boundary.

B21tca—15 to 26 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; hard, friable; many fine pores; patchy clay films; common worm casts; few fine concretions

and many films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B22tca—26 to 45 inches, reddish-yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak, coarse, prismatic structure parting to weak, fine, subangular blocky; hard, friable; few fine roots; few fine pores; patchy clay films; 35 percent, by volume, masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B23tca—45 to 70 inches, reddish-yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; hard, friable; few fine pores; patchy clay films; 20 percent, by volume, concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B24tca—70 to 82 inches, red (2.5YR 5/8) silty clay loam, red (2.5YR 4/8) moist; weak, coarse, prismatic structure parting to weak, fine, subangular blocky; hard, friable; few fine pores; patchy clay films; 5 percent, by volume, small concretions and soft masses of calcium carbonate.

The A horizon is 12 to 19 inches thick. It is brown, grayish brown, and dark grayish brown. The Bt horizon extends to a depth of 75 inches to more than 90 inches and is brown to reddish yellow, yellowish red, light reddish brown, reddish brown, and red. It is mostly clay loam but changes to sandy clay loam or silty clay loam. The B21tca horizon is 10 to 20 percent visible calcium carbonate, the B22tca horizon is 30 to 40 percent carbonate, and the B23tca horizon and the B24tca horizon are 15 to 20 percent carbonate.

**Estacado clay loam, 0 to 1 percent slopes (EsA).**—This nearly level soil is in two distinct areas. It is in playa depressions and in flat areas on uplands near drainageways and near playa depressions. Most areas are less than 300 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are some lower-lying areas of a soil that is similar to Estacado soil but has a darker colored surface layer to a depth of 20 to 30 inches. Also included are some areas of Mansker, Olton, Posey, and Tulia soils and areas of an Estacado soil that has slopes of more than 1 percent.

This Estacado soil is used mostly for crops. Most cultivated areas are irrigated, but a few areas are dryfarmed. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are controlling erosion and conserving moisture. Runoff is slow. The hazard of soil blowing is moderate, and the hazard of erosion is slight.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to control soil blowing and conserve moisture. An example of a suitable cropping system is cotton followed by grain sorghum, wheat, or some other high-residue crop every other year.

In areas where this soil is irrigated, a properly designed irrigation system is needed to provide adequate water for crops and prevent soil and water losses. Using diversion terraces, grassed waterways, contour farming, and land leveling help to control erosion and conserve moisture. Using fertilizer and some trace elements helps to overcome plant nutrient deficiencies. Capability unit IIIe–5, dryland, and IIe–1, irrigated; Hardland Slopes range site.

**Estacado clay loam, 1 to 3 percent slopes (EsB).**—This gently sloping soil is mostly in playa basins. Areas are narrow and elongated in shape and are 10 to 200 acres in size. Most areas circle playa lakes on the upper edge. Slopes average about 1.7 percent.

The surface layer is dark grayish-brown, calcareous clay loam about 16 inches thick. The next layer is 8 inches of brown, friable clay loam that has many films and threads of calcium carbonate. Below this is about 23 inches of reddish-yellow, friable clay loam that is about 35 percent calcium carbonate. The next layer is about 15 inches of reddish-brown, friable clay loam that is about 20 percent calcium carbonate. Below this to a depth of 82 inches is yellowish-red clay loam that is about 15 percent calcium carbonate.

Included with this soil in mapping are some areas of Mansker, Olton, Posey, and Tulia soils. Also included are a few small areas that have no layers of calcium carbonate accumulation or that have layers of calcium carbonate accumulation more than 30 inches from the surface. Some areas of Estacado clay loam, 0 to 1 percent slopes, are also included.

This Estacado soil is used mostly for crops. Most cultivated areas are irrigated, but a few areas are dryfarmed. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are controlling soil blowing and erosion and conserving moisture. Runoff is slow. The hazards of soil blowing and erosion are moderate.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface helps to prevent soil blowing and conserve moisture. An example of a suitable cropping system is cotton or some other row crop followed by grain sorghum, wheat, or some other high-residue crop every other year.

In areas where this soil is irrigated, a properly designed surface or sprinkler irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces, grassed waterways, contour farming, and terracing help to control erosion and conserve soil moisture. Using fertilizer and some trace elements helps to overcome plant nutrient deficiencies. Capability unit IIIe–2, dryland, and IIIe–2, irrigated; Hardland Slopes range site.

## Flomot Series

The Flomot series consists of gently sloping to strongly sloping soils in upland areas below the Caprock. These soils formed in loamy calcareous material.

In a representative profile the surface layer is brown, calcareous fine sandy loam about 7 inches thick. Below this is 5 inches of light-brown, friable loam that is about 35 percent calcium carbonate. The next layer is about 25 inches of light reddish-brown, friable loam that is about 48 percent calcium carbonate. Below this is yellowish-red, friable loam that is about 20 percent calcium carbonate and extends to a depth of 70 inches (fig. 5).

Flomot soils are well drained. Runoff is medium to rapid, and permeability is moderate. Available water capacity is medium. In some places free lime in the

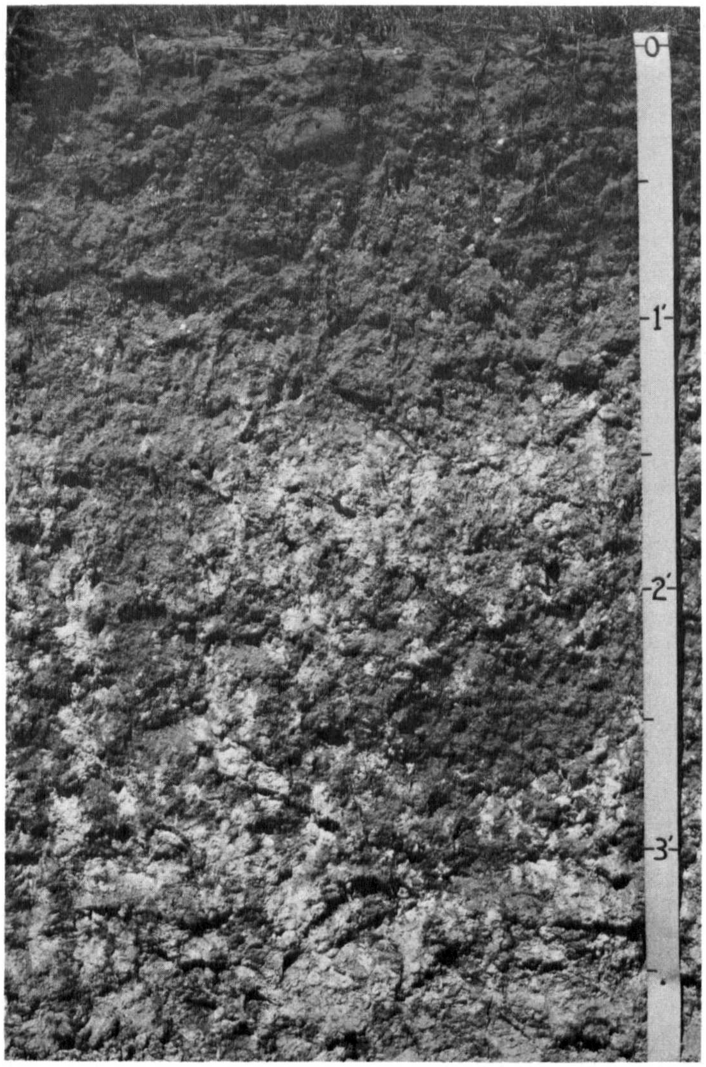


*Figure 5.*—**Profile of Flomot fine sandy loam showing many masses and concretions of calcium carbonate.**

surface layer causes a deficiency of plant nutrients in some crops.

These soils are used mostly as range, but soils in a few of the less sloping areas are dryfarmed.

Representative profile of Flomot fine sandy loam, 3 to 5 percent slopes, 11.9 miles east and northeast of Cedar Hill on Farm Road 97 to its intersection with the Motley County line, then 2.2 miles north along county line road and 100 feet west of the road, in range:

A1—0 to 7 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak, fine, granular structure; slightly hard, very friable; few roots; few strongly cemented calcium carbonate concretions as much as 1 centimeter in diameter; calcareous; moderately alkaline; clear, smooth boundary.

B21ca—7 to 12 inches, light-brown (7.5YR 6/4) loam, dark brown (7.5YR 4/4) moist; moderate, fine, granular structure and medium, subangular blocky structure; hard, friable; few roots; many worm casts; 35 percent soft masses and weakly to strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B22ca—12 to 37 inches, light reddish-brown (5YR 6/4) loam, reddish brown (5YR 4/4) moist; weak, medium, subangular blocky structure; hard, friable; few roots; few fine pores; few worm casts in upper part; 48 percent, by volume, soft masses and weakly to strongly cemented concretions of calcium carbonate as much as 3 centimeters in diameter; calcareous; moderately alkaline; diffuse, smooth boundary.

B23tca—37 to 70 inches, yellowish-red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak, medium, subangular blocky structure; slightly hard, friable; few pores; patchy clay films visible on surface of peds; 20 percent, by volume, soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 inches to more than 80 inches in thickness. The A1 horizon is 5 to 12 inches in thickness and is reddish brown or light brown to brown. The B2ca horizon is at a depth of 7 to 18 inches. It is reddish-brown to light reddish-brown, yellowish-red, reddish-yellow, or light-brown loam or sandy clay loam. At a depth of 10 to 40 inches, this horizon is 40 to 60 percent, by volume, calcium carbonate. The B2t horizon is red to yellowish-red and reddish-yellow loam or sandy clay loam.

**Flomot fine sandy loam, 1 to 3 percent slopes (FoB).**—This gently sloping soil is on uplands. Most areas are 4 to 90 acres in size, but a few are larger. Slopes average 2.5 percent.

The surface layer is brown, calcareous fine sandy loam about 8 inches thick. Below this is 9 inches of reddish-brown, friable loam that is about 40 percent calcium carbonate. The next layer is 23 inches of reddish-yellow, friable loam that is 60 percent calcium carbonate. The next layer is 32 inches of red, friable loam that is about 3 percent calcium carbonate. Below this is red, friable clay loam that is about 10 percent calcium carbonate and extends to a depth of 85 inches.

Included with this soil in mapping are small areas of Flomot soils that have slopes of 0 to 1 percent and areas of Amarillo, Berda, Mobeetie, Paloduro, and Springer soils. Also included are a few areas of soils that have a dark-colored surface layer and some areas that have layers of calcium carbonate accumulation that is less than 40 percent calcium carbonate. Some areas are underlain by red beds and have no layers of clay accumulation.

A little more than half of this Flomot soil is used for crops, and the rest is in range. A few small areas are irrigated. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are controlling erosion, conserving moisture, and using cropping systems that overcome soil limitations. Runoff is medium. The hazards of soil blowing and erosion are moderate.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to control soil blowing and erosion and to conserve moisture. An example of a suitable cropping system is 1 year of cotton followed by 3 years of grain sorghum, wheat, or some other high-residue crop.

In areas where this soil is irrigated, a properly designed sprinkler irrigation system is needed to provide adequate water for crops and to prevent soil and water

losses. Using diversion terraces and grassed waterways, terracing, and contour farming help to prevent erosion and conserve moisture. The use of fertilizer and some trace elements helps to overcome plant nutrient deficiencies. Capability unit IVe–1, dryland, and IIIe–4, irrigated; Mixedland Slopes range site.

**Flomot fine sandy loam, 3 to 5 percent slopes** (FoC).—This gently sloping soil is on uplands. Areas along natural drainageways are longer than they are wide, and areas away from drainageways are oval to irregular in shape. Areas range from 5 to 150 acres in size but are mainly less than 40 acres. Slopes average about 4 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas less than 5 acres in size of Flomot fine sandy loam, 1 to 3 percent slopes, and Flomot soils that have slopes of more than 5 percent. Also included are a few areas of Amarillo, Berda, and Springer soils. A few small areas of soils that have a dark-colored surface layer and some areas that have less than 40 percent calcium carbonate at a depth of 10 to 40 inches are also included. Some areas are underlain by red beds and have no layers of clay accumulation.

About a third of this soil is in crops, and the rest is used as range. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are controlling erosion, conserving moisture, and using cropping systems that overcome soil limitations. Runoff is rapid. The hazard of soil blowing is moderate, and the hazard of erosion is severe.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to control soil blowing and erosion and to conserve moisture. An example of a suitable cropping system is grain sorghum, wheat, or some other high-residue crop grown each year.

In areas where this soil is irrigated, a properly designed sprinkler irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces and grassed waterways, terracing, and contour farming help to prevent erosion and conserve moisture. The use of fertilizer and some trace elements helps to overcome plant nutrient deficiencies. Capability unit IVe–3, dryland, and IVe–2, irrigated; Mixedland Slopes range site.

**Flomot fine sandy loam, 5 to 12 percent slopes** (FoD).—This sloping to strongly sloping soil is in irregularly shaped areas on uplands. It is mainly along drainageways. Areas are 20 to 60 acres in size. Slopes average 9 percent.

The surface layer is brown, calcareous fine sandy loam about 5 inches thick. Below this is about 7 inches of light-brown, friable loam that is about 28 percent calcium carbonate. The next layer is 38 inches of light reddish-brown, friable loam that is about 53 percent calcium carbonate. Below this is reddish-yellow, friable sandy clay loam that is about 25 percent calcium carbonate and extends to a depth of 60 inches.

Included with this soil in mapping are areas of Amarillo, Berda, and Springer soils. Also included are a few areas of soils that have a dark-colored surface layer and some areas that have layers of calcium carbonate accumulation that are less than 40 percent calcium carbonate. Some areas are underlain by red beds and have no layers of clay accumulation.

This soil is used as range. The main concerns in management are controlling erosion and conserving moisture. Runoff is rapid. The hazard of soil blowing is moderate, and the hazard of erosion is severe.

Maintaining a minimum of 50 percent of a season's growth of grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass help to control soil blowing and erosion. Controlling brush by chemical or mechanical methods helps to conserve moisture. A brush-control program should allow for planned areas of wildlife habitat. Capability unit VIe–2, dryland; Mixedland Slopes range site.

## Latom Series

The Latom series consists of very shallow to shallow, sloping to moderately steep, loamy soils on uplands. These soils formed in thin loamy material weathered from sandstone.

In a representative profile the surface layer is brown, calcareous fine sandy loam about 16 inches thick. The underlying material is very pale brown, strongly cemented, calcareous sandstone.

Latom soils are well drained. Runoff is rapid, and permeability is moderate. Available water capacity is very low.

These soils are used as range.

Representative profile of Latom fine sandy loam in an area of Latom soils and Rock outcrop, 5 to 20 percent slopes, 9.9 miles east and northeast on Farm Road 97 from Cedar Hill, then 100 feet north of the road, in range:

A1—0 to 16 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; soft, very friable; many grass roots; common small sandstone fragments in lower part; calcareous; moderately alkaline; abrupt, smooth boundary.

R—16 to 25 inches, very pale brown (10YR 7/4) strongly cemented calcareous sandstone; thin coatings of calcium carbonate in crevices.

The A1 horizon is 4 to 16 inches thick and is light brown, reddish brown, light reddish brown, or brown. It ranges from a few pebbles to as much as 25 percent, by volume, gravel and is mildly alkaline or moderately alkaline. The R layer ranges from strongly cemented sandstone to conglomerate rock. Calcium carbonate ranges from none to thin discontinuous coatings on the rock. The layer is mildly alkaline or moderately alkaline.

**Latom soils and Rock outcrop, 5 to 20 percent slopes** (LaE).—This mapping unit is in rough, sloping to moderately steep areas 50 acres to several thousand acres in size (fig. 6). A mapped area is ordinarily 32 percent Latom soils; 15 percent Rock outcrop; 46 percent a soil that is similar to Latom soils but is less than 4 inches deep to sandstone; and 7 percent other soils. The percentage of Latom soils ranges from 25 to 45, the percentage of Rock outcrop and soils less than 4 inches thick from 50 to 75, and the percentage of other soils from 1 to 20 percent.

Areas of this mapping unit have a "stairstep" appearance. The difference in elevation from the top of

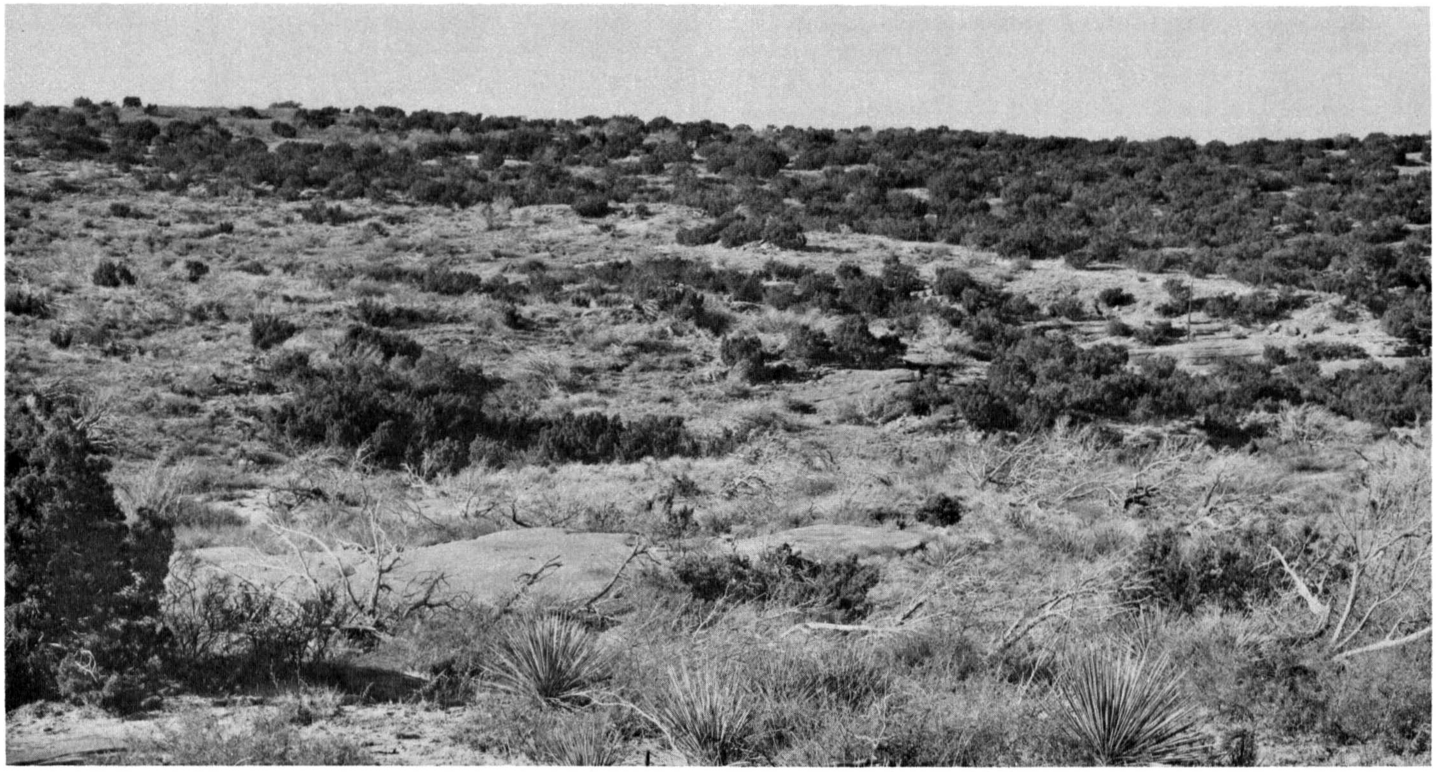

*Figure 6.*—**Area of Latom soils and Rock outcrop, 5 to 20 percent slopes.**

ridges to the bottom ranges from 30 to 130 feet but is dominantly 40 to 80 feet. The soils on or near the top of the ridges are sloping to strongly sloping, and those on the side slopes are strongly sloping to moderately steep. Large areas of sandstone and conglomerate rock outcrop are on the steeper slopes. Most of the soil that forms in these steeper areas moves downslope to more nearly level areas or becomes colluvium in drainageways.

Included in this mapping unit are areas less than 10 acres in size of Amarillo, Berda, Likes, Mobeetie, and Springer soils. A soil that is similar to Latom soils but is more than 20 inches deep to sandstone is included in some areas.

The soils in this mapping unit are used as range and wildlife habitat. The main concerns in management are controlling erosion and conserving moisture. Runoff is rapid. The hazard of soil blowing is moderate, and the hazard of erosion is severe.

Maintaining a minimum of 50 percent of a season's growth of grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass help to control soil blowing and erosion. Capability unit VIIs–1, dryland; Very Shallow range site.

## Likes Series

The Likes series consists of deep, gently sloping to sloping, sandy soils on uplands. These soils formed in unconsolidated sand and sandstone.

In a representative profile the surface layer is grayish-brown loamy fine sand about 8 inches thick. The next layer is light-brown, very friable loamy fine sand about 18 inches thick. The underlying material is very pale brown, calcareous fine sand that extends to a depth of 60 inches.

Likes soils are excessively drained. Runoff is slow, and permeability is moderately rapid. Available water capacity is low.

These soils are used as range and wildlife habitat.

Representative profile of Likes loamy fine sand, 3 to 8 percent slopes, 1.8 miles north of South Plains on Texas Highway 207, then 6 miles east on a county road, then 1 mile north and 3.6 miles east and northeast on the same county road, then 200 feet south of the road, in range:

A1—0 to 8 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; soft, very friable; few worm casts; many roots; mildly alkaline; clear, smooth boundary.

C1—8 to 26 inches, light-brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; single grained; loose, very friable; few roots; calcareous; moderately alkaline; diffuse, smooth boundary.

C2—26 to 60 inches, very pale brown (10YR 8/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose; thin coating of calcium carbonate on lower side of a few quartz pebbles; calcareous; moderately alkaline.

The A1 horizon is 7 to 10 inches thick. It is light brownish gray, brown, or grayish brown and is mildly alkaline or moderately alkaline. The C1 horizon and the C2 horizon are light brown, very pale brown, or pale-brown loamy fine sand and fine sand. In some places the horizon has a few soft masses, concretions, and other concentrations of calcium carbonate.

**Likes loamy fine sand, 3 to 8 percent slopes** (LkD).—This gently sloping to sloping soil is on concave foot slopes and hummocky to duny uplands east of the High Plains Escarpment and along the larger streams. Areas are mainly irregular in shape and are 10 to 50 acres in size.

Included with this soil in mapping are areas of Berda, Latom, and Mobeetie soils. Also included are some areas of soils that have developed more distinct horizons and a few areas that have a dark-colored surface layer. A few areas of soils that have layers of calcium carbonate accumulation in the lower part and a few areas of soils that have sandstone fragments are also included.

This Likes soil is used as range and wildlife habitat. The main concerns in management are controlling erosion and conserving moisture. Runoff is slow. The hazards of soil blowing and erosion are severe.

Reseeding cultivated areas to native grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass help to control soil blowing and erosion. Controlling brush by chemical or mechanical methods helps to conserve moisture. A brush-control program should allow for planned areas of wildlife habitat. Capability unit VIe-1, dryland; Sandy range site.

## Lincoln Series

The Lincoln series consists of deep, nearly level, sandy soils on flood plains along major streams. These soils formed in recent, sandy, alluvial material.

In a representative profile the surface layer is light-brown fine sandy loam about 14 inches thick. The underlying material is pink fine sand that extends to a depth of 65 inches (fig. 7).

Lincoln soils are excessively drained. Runoff is slow, and permeability is rapid. Available water capacity is low. A water table is between a depth of 3 and 10 feet in most areas.

These soils are used mainly as range. They are not suited to cultivation. Some areas are used as improved pasture. The soils are subject to flooding during periods of high rainfall and are flooded once every 1 to 3 years in most areas.

Representative profile of Lincoln fine sandy loam in an area of Lincoln soils, frequently flooded, 10.6 miles east and northeast of Cedar Hill on Farm Road 97, then 2.3 miles north on Farm Road 1065, then 1 mile west on a county road and about 1.5 miles north on a second county road, then 1 mile west on a third county road and 0.35 mile north on another county road, then 100 feet east of the road, in range:

A1—0 to 14 inches, light-brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak, fine and medium, granular structure; slightly hard, very friable; many fine roots; thin strata of dark-brown (7.5YR 4/4) loam; calcareous; moderately alkaline; clear, smooth boundary.

C—14 to 65 inches, pink (7.5YR 7/4) fine sand, light brown (7.5YR 6/4) moist; single grained; loose; very friable; few fine roots; evident bedding planes; distinct fine sandy loam, very fine sandy loam, and loamy fine sand strata ⅛ inch to 2 inches wide scattered throughout; gravel strata 1 inch to 3 inches wide in lower part; calcareous; moderately alkaline.

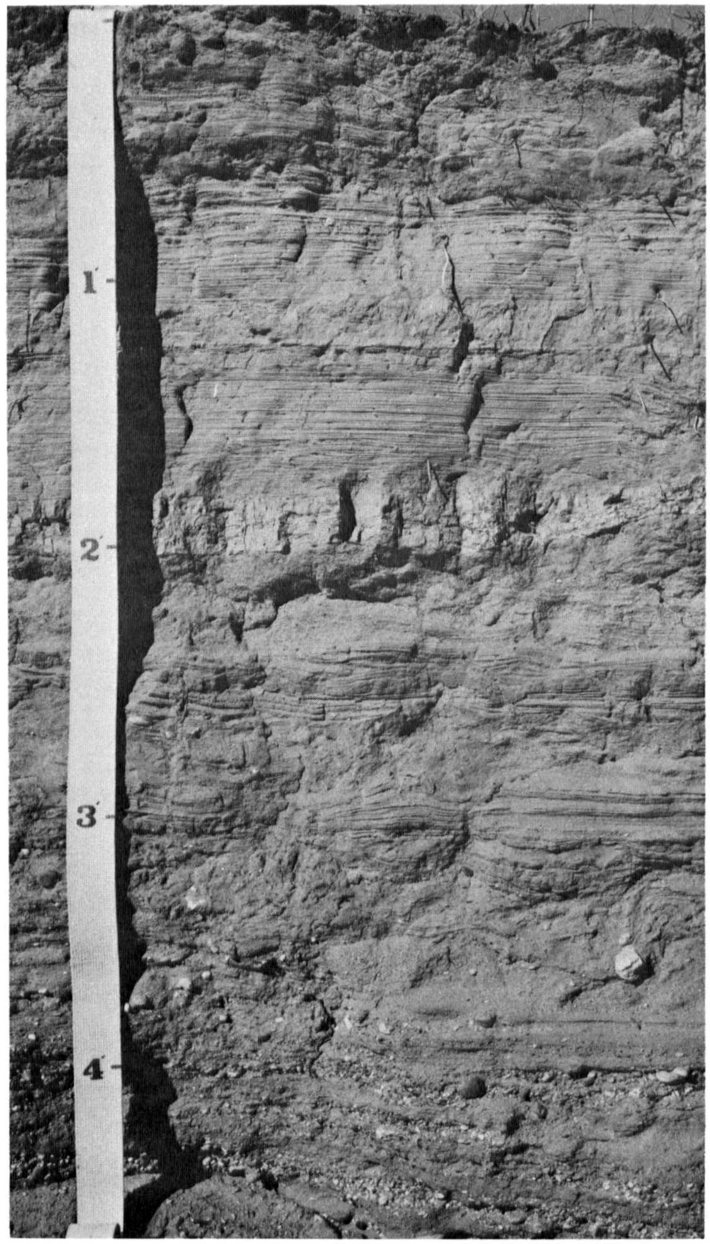


*Figure 7.*—**Profile of Lincoln fine sandy loam showing bedding planes and stratification.**

The A1 horizon is 6 to 14 inches thick. It is reddish-brown, reddish-yellow, or light-brown loamy fine sand to fine sandy loam. The C horizon is light reddish-brown or pink loamy fine sand or fine sand. It has distinct bedding planes and thin strata of very fine sandy loam to fine sandy loam that are darker and have more organic matter than the remainder of the soil. The distribution of organic matter is irregular throughout the soil. In most places the C horizon has strata of gravel.

**Lincoln soils, frequently flooded** (Ln).—These nearly level soils are on flood plains along major streams. Most areas are narrow in shape, are parallel to stream

channels, and are 10 to 100 acres in size. Slopes are 0 to 1 percent.

Included with these soils in mapping are areas of soils that have a loam surface layer and a few areas of soils that have a clay loam surface layer.

These Lincoln soils are used as range and wildlife habitat. The soils are flooded once every 1 to 3 years for a short period of time. A few areas are flooded more often. The main concern in management is controlling erosion. Runoff is slow. The hazard of soil blowing is severe.

Maintaining a minimum of 50 percent of a season's growth of grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass help to control soil blowing. A brush-control program should allow for planned areas of wildlife habitat. Capability unit Vw-2, dryland; Sandy Bottomland range site.

## Lofton Series

The Lofton series consists of deep, nearly level soils on low benches surrounding playa lakes and in small, shallow depressions on uplands. These soils formed in calcareous clayey material.

In a representative profile the surface layer is dark grayish-brown clay loam about 7 inches thick. Below this is 15 inches of dark grayish-brown, firm clay over grayish-brown, very firm and firm, calcareous clay about 33 inches thick. The next layer is about 18 inches of light brownish-gray, firm clay that is about 5 percent calcium carbonate. Below this is white, friable silty clay that extends to a depth of 86 inches (fig. 8).

Lofton soils are mainly in areas that receive runoff from surrounding areas. These soils are moderately well drained. Runoff is very slow to ponded, and permeability is very slow. Available water capacity is high.

These soils are used mostly for crops. Most areas are irrigated, but some are dryfarmed. A few areas are in native vegetation and are used as range.

Representative profile of Lofton clay loam, 0.5 mile east of the county courthouse in Floydada and 4.5 miles north on Texas Highway 207, then 0.8 mile west on a county road, then 0.8 mile north on another county road and 200 feet east of the road, in a cultivated field:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; hard, friable; mildly alkaline; abrupt, smooth boundary.

B21t—7 to 22 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, medium, blocky structure; extremely hard, firm; many roots between faces of peds; some micronodular or knobby ped faces; continuous clay films; mildly alkaline; gradual, smooth boundary.

B22t—22 to 40 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; strong, medium, blocky structure; some wedge-shaped peds tilted about 15 degrees from the horizontal; extremely hard, very firm; continuous clay films; calcareous; moderately alkaline; gradual, wavy boundary.

B23t—40 to 55 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate, medium, blocky structure; very hard, firm; clay films on most faces of peds; few small concretions, films, and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B24tca—55 to 73 inches, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; weak, medium, subangular blocky structure; hard, firm; about 5 percent, by volume, films, threads, and few small concretions of calcium carbonate; few films of calcium sulfate; calcareous; moderately alkaline; clear, wavy boundary.

B25tca—73 to 86 inches, white (2.5Y 8/2) silty clay, light gray (2.5Y 7/2) moist; weak, medium, subangular blocky structure; hard, friable; 10 percent, by volume, films, threads, and few concretions of calcium carbonate; calcareous; moderately alkaline.


*Figure 8.*—**Profile of Lofton clay loam showing dark-colored surface layer and blocky clay below a depth of 22 inches.**

The A horizon is 6 to 10 inches thick. It is dark grayish brown, very dark grayish brown, very dark gray, or dark

gray. The B2t horizon is dark gray, dark grayish brown, very dark gray, and grayish brown. It is 40 to 50 percent clay. The B2tca horizon is at a depth of 45 to 60 inches. It is white, gray, grayish-brown, or light brownish-gray clay or silty clay. This horizon is 10 to 40 percent, by volume, calcium carbonate. The depth to free carbonates ranges from 16 to 30 inches. In most places vertical lenses of the A horizon material can be seen at depths of 30 to 40 inches.

**Lofton clay loam** (Lo).—This nearly level soil is on the first bench above the playa lakebeds. Areas are oval in shape and are mostly on the eastern and southern sides of playa lakes. Some areas are in slightly depressional concave areas on uplands. Slopes average about 0.5 percent. Areas average less than 100 acres in size.

Included with this soil in mapping are a few areas of soils that are calcareous to the surface. Also included are small areas of Mansker, Olton, and Pullman soils. In some areas narrow bands of soils that are similar to Lofton soils but have 1 to 3 percent slopes are included.

This Lofton soil is used mostly for crops. Most cultivated areas are irrigated, but a few areas are dryfarmed. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are maintaining tilth, controlling erosion, and conserving moisture. Runoff is slow to ponded. The hazards of soil blowing and erosion are slight.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth, prevent soil blowing, and conserve moisture. Avoiding tillage operations on this soil when it is wet helps to maintain tilth. An example of a suitable cropping system is cotton followed by grain sorghum, wheat, or some other high-residue crop every other year.

In areas where this soil is irrigated, a properly designed surface irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Capability unit IIIe–4, dryland, and IIs–1, irrigated; Clay Loam range site.

## Mansker Series

The Mansker series consists of deep, gently sloping, loamy soils on uplands. These soils are in areas along drainageways and in areas within many of the playa basins. They formed in calcareous loamy material.

In a representative profile the surface layer is brown, calcareous clay loam about 14 inches thick. Below this is friable clay loam. It is light brown and is about 45 percent calcium carbonate in the upper 4 inches and is pink and is about 65 percent calcium carbonate in the lower 17 inches. The next layer to a depth of 75 inches is yellowish-red, friable clay loam that is about 20 percent calcium carbonate (fig. 9).

Mansker soils are well drained. Runoff is medium to rapid, and permeability is moderate. Available water capacity is medium. In some places the high lime content of the soils causes a deficiency of plant nutrients in some crops.

These soils are used mostly for crops. Some areas are irrigated. Areas in native vegetation are used as range.

*Figure 9.*—**Profile of Mansker clay loam showing concretions and masses of calcium carbonate.**

Representative profile of Mansker clay loam, 3 to 5 percent slopes, 5.2 miles east on Farm Road 97 from its intersection with Farm Road 378 in Lockney, then 0.5 mile south on a county road and 100 feet east of the road, in range:

A1—0 to 14 inches, brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; weak, medium, granular structure; slightly hard, friable; common roots; many fine pores; many worm casts; few strongly cemented concretions of calcium carbonate that are less than 1 centimeter in diameter; calcareous; moderately alkaline; clear, smooth boundary.

B21ca—14 to 18 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak, coarse, prismatic structure parting to moderate, medium, granular; slightly hard, friable; few fine roots; many fine pores; many worm casts; about 45 percent, by volume, common strongly cemented and few weakly cemented concretions of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

B22ca—18 to 35 inches, pink (5YR 7/4) clay loam, reddish brown (5YR 5/4) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable; few roots; few pores; about 65 percent, by volume, weakly cemented concretions, soft powdery masses, and few strongly cemented concretions as much as 2 centi-

meters in diameter of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

B23tca—35 to 75 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable; few pores; about 20 percent, by volume, weakly cemented concretions as much as about 2 centimeters in diameter; few thin clay films; calcareous; moderately akaline.

The A1 horizon is 6 to 14 inches thick. It is brown, grayish brown, or dark grayish brown. The B2ca horizon is at a depth of 10 to 20 inches. It is pink, light-brown, brown, and reddish-brown loam or clay loam and is 40 to 65 percent, by volume, calcium carbonate. The B2tca horizon is red, reddish-yellow, or yellowish-red clay loam or sandy clay loam. It is 15 to 30 percent, by volume, calcium carbonate.

**Mansker clay loam, 1 to 3 percent slopes** (MaB).—This gently sloping soil is in convex areas on narrow bands along major draws and within playa basins. Areas average about 25 acres in size. Slopes average about 2 percent.

The surface layer is brown, calcareous clay loam about 12 inches thick. The next layer is about 7 inches of brown, friable clay loam that is about 27 percent calcium carbonate. Below this is about 17 inches of pink, friable clay loam that is about 60 percent calcium carbonate. The next layer to a depth of 65 inches is reddish-yellow, friable clay loam that is about 30 percent calcium carbonate.

Included with this soil in mapping are areas of Estacado, Olton, Posey, Pullman, and Tulia soils and a few areas of Mansker soils that have slopes of more than 3 percent. Also included are a few areas of cultivated soils that are eroded and have a few small gullies which can be crossed by farm machinery.

This Mansker soil is used mostly for crops. Some areas are irrigated. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are controlling soil blowing and erosion, maintaining tilth, conserving moisture, and using cropping systems that overcome soil limitations. Runoff is medium. The hazard of soil blowing is severe, and the hazard of erosion is moderate.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to control soil blowing and erosion, maintain tilth, and conserve moisture. An example of a suitable cropping system is cotton followed by grain sorghum, wheat, or some other high-residue crop for 3 years.

In areas where this soil is irrigated, a properly designed irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces and grassed waterways, terracing, and contour farming help to control erosion. The use of fertilizer and some trace elements helps to overcome plant nutrient deficiencies. Capability unit IVe–1, dryland, and IIIe–4, irrigated; Hardland Slopes range site.

**Mansker clay loam, 3 to 5 percent slopes** (MaC).—This gently sloping soil is in steep, convex areas along draws and within playa basins. Areas are mostly long and narrow in shape and are 5 to 150 acres in size. Slopes average about 4 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Estacado, Olton, Posey, Pullman, and Tulia soils. A few areas of Mansker soils that have slopes of less than 3 percent and some areas of Mansker soils that have slopes of more than 5 percent are included. Also included are a few areas of cultivated soils that are eroded and have gullies which can be crossed by farm machinery.

This Mansker soil is used mostly for crops. Some areas are irrigated. Grain sorghum and wheat are the main crops. The main concerns in management are controlling erosion and soil blowing, maintaining tilth, conserving moisture, and using cropping systems that overcome soil limitations. Runoff is rapid. The hazards of soil blowing and erosion are severe.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to control soil blowing and erosion, maintain tilth, and conserve moisture. An example of a suitable cropping system is grain sorghum, wheat, or some other high-residue crop grown each year.

In areas where this soil is irrigated, a properly designed sprinkler irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces and grassed waterways, terracing, and contour farming help to control erosion and conserve moisture. The use of fertilizer and some trace elements helps to overcome plant nutrient deficiencies. Capability unit IVe–3, dryland, and IVe–2, irrigated; Hardland Slopes range site.

## Mobeetie Series

The Mobeetie series consists of deep, nearly level to gently sloping, loamy soils on foot slopes or old alluvial fans on uplands. These soils formed in loamy calcareous material mainly derived from the Ogallala Formation.

In a representative profile the surface layer is reddish-brown, calcareous fine sandy loam about 10 inches thick. The next layer is reddish-brown and light reddish-brown, very friable fine sandy loam about 30 inches thick that has a few films and threads of calcium carbonate. The underlying material is pink, calcareous loamy fine sand that extends to a depth of 72 inches.

Mobeetie soils are well drained. Runoff is medium, and permeability is moderately rapid. Available water capacity is medium. In some places the high lime content of the soils causes a deficiency of plant nutrients in some crops.

These soils are used mainly for dryland crops, but some areas are irrigated. A few areas are in native vegetation and are used as range.

Representative profile of Mobeetie fine sandy loam, 0 to 3 percent slopes, 10.6 miles east and northeast of Cedar Hill on Farm Road 97, then 2.25 miles north on Farm Road 1065, then 1 mile west on a county road and 0.8 mile south on another county road, then 150 feet east of the road, in a cultivated field:

Ap—0 to 10 inches, reddish-brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; slightly hard, very friable;

few pebbles and large fragments of caliche; calcareous; moderately alkaline; clear, smooth boundary.

B21—10 to 25 inches, reddish-brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky and granular; slightly hard, very friable; few fine pores; few worm casts; few films and threads of calcium carbonate; few caliche fragments; calcareous; moderately alkaline; diffuse, wavy boundary.

B22—25 to 40 inches, light reddish-brown (5YR 6/4) fine sandy loam, reddish brown (5YR 5/4) moist; weak, coarse, prismatic structure; soft, very friable; few strata about 2 inches thick of fine-size and medium-size gravel; few films and threads of calcium carbonate; few caliche fragments; calcareous; moderately alkaline; diffuse, wavy boundary.

C—40 to 72 inches, pink (5YR 7/4) loamy fine sand, light reddish brown (5YR 6/4) moist; single grained; few thin strata of fine-size and medium-size gravel and few strata of coarse sand; few films and threads of calcium carbonate; calcareous; moderately alkaline.

The A horizon is 8 to 14 inches thick and is reddish brown or brown. The surface is covered by a few to almost 100 percent caliche fragments. The B horizon is 15 to 40 inches thick. It is reddish brown, light reddish brown, light brown, and brown. At a depth of 10 to 40 inches, this horizon is 12 to 18 percent clay. The C horizon is pink, light reddish brown, light brown, and reddish yellow. Calcium carbonate ranges from a few films, threads, and soft concretions to as much as about 10 percent, by volume. Caliche fragments range from a few to 5 percent, by volume.

**Mobeetie fine sandy loam, 0 to 3 percent slopes** (MoB).—This nearly level to gently sloping soil is on old alluvial fans that are hummocky in some areas and are nearly level on the top and gently sloping on the edges in other areas. Areas are mostly small and irregularly shaped or fan shaped and are a few acres to 40 acres in size. Slopes average about 1 percent.

Included with this soil in mapping are small areas of Berda soils that are along the margins of mapped areas and are less than a few acres in size. Also included are Paloduro soils in some small areas along the margins of the mapping unit and in small low areas.

This Mobeetie soil is used mostly for crops. A few areas are irrigated. Cotton, grain sorghum, and wheat are the main crops. Some areas are used for hay. The main concerns in management are controlling soil blowing and erosion, conserving moisture, and using cropping systems that overcome soil limitations. Runoff is medium. The hazard of soil blowing is severe, and the hazard of erosion is moderate.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to control soil blowing and erosion and conserve moisture. An example of a suitable cropping system is 1 year of cotton followed by 3 years of grain sorghum, wheat, or some other high-residue crop.

In areas where this soil is irrigated, a properly designed sprinkler irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces and grassed waterways, terracing, and contour farming help to control erosion and conserve moisture. The use of fertilizer and some trace elements helps to overcome plant nutrient deficiencies. Capability unit IVe–4, dryland, and IIIe–3, irrigated; Mixedland Slopes range site.

## Obaro Series

The Obaro series consists of moderately deep to deep, sloping to strongly sloping, loamy soils on uplands. These soils formed in weakly consolidated, fine-grained, calcareous sandstone.

In a representative profile the surface layer is reddish-brown, calcareous loam about 7 inches thick. The next layer is yellowish-red and red, calcareous loam about 27 inches thick. It is about 10 percent calcium carbonate in the lower part. The underlying material is red, weakly cemented sandstone that extends to a depth of 60 inches.

Obaro soils are well drained. Runoff is medium, and permeability is moderate. Available water capacity is medium.

These soils are used as range and wildlife habitat.

Representative profile of Obaro loam in an area of Obaro and Quinlan soils, 5 to 12 percent slopes, 11.4 miles east and northeast of Cedar Hill on Farm Road 97, then 100 feet north of the road, in range:

A1—0 to 7 inches, reddish-brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) moist; weak, subangular blocky structure; slightly hard, very friable; many roots; few small concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B2—7 to 17 inches, yellowish-red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; compound weak, coarse, prismatic and moderate, medium, subangular blocky structure; slightly hard, friable; many roots; few pores; common worm casts; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B3ca—17 to 34 inches, red (2.5YR 5/6) loam, red (2.5YR 4/6) moist; compound weak, coarse, prismatic and weak, medium, subangular blocky structure; slightly hard, very friable; about 10 percent, by volume, films, threads, soft powdery masses, and few concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

C—34 to 60 inches, red (2.5YR 5/6) weakly cemented sandstone, red (2.5YR 4/6) moist.

The solum ranges from 20 to 42 inches in thickness. Between depths of 10 and 40 inches, the soil is 18 percent to more than 30 percent clay, but in most places it is 20 to 25 percent clay. The A1 horizon is reddish-brown or brown loam to sandy clay loam. The B horizon is reddish brown, light reddish brown, reddish yellow, yellowish red, and red. Calcium carbonate ranges from films and threads to about 25 percent, by volume. The lower part of the B horizon has a few to 6 percent, by volume, sandstone fragments. The C horizon is weakly cemented sandstone to siltstone. It has blue-green splotches and strata that range from none to as much as 50 percent of the parent material.

**Obaro and Quinlan soils, 5 to 12 percent slopes** (ObD).—This mapping unit is made up of sloping to strongly sloping soils on knolls and side slopes. It is 45 percent Obaro soils, 40 percent Quinlan soils, and 15 percent other soils. Areas are irregular in shape and 5 to 50 acres in size. Slopes average 8 percent. The soils in this mapping unit are intricately intermingled, but not in a regular pattern.

The Obaro soils are mostly on side slopes, in slightly concave areas, and in smoother areas in the mapping unit. Areas are less than 1 acre to more than 5 acres in size.

The Quinlan soils are mostly on the top of knolls or ridges, in convex areas on side slopes, and in steeper

areas of the mapping unit. Most areas are less than 1 acre to 5 acres in size.

Included with these soils in mapping are red-bed outcrops, mostly in areas of Quinlan soils.

The soils in this mapping unit are used as range and wildlife habitat. The main concerns in management are controlling soil blowing and erosion and conserving moisture. The hazard of soil blowing is moderate, and the hazard of erosion is severe.

Reseeding cultivated areas to native grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass help to control soil blowing and erosion and conserve moisture. Controlling brush by chemical or mechanical methods helps to conserve moisture. A brush-control program should allow for planned areas of wildlife habitat. Capability unit VIe-3, dryland; Mixedland range site.

## Olton Series

The Olton series consists of deep, nearly level to gently sloping, loamy soils on uplands. These soils formed in loamy, calcareous, eolian material that was deposited over the High Plains.

In a representative profile the surface layer is reddish-brown clay loam about 9 inches thick. The next layer is reddish-brown firm clay and clay loam about 22 inches thick. Below this is about 13 inches of yellowish-red clay loam that has a few films and threads of calcium carbonate. The next layer is about 28 inches of pink clay loam that is about 40 percent calcium carbonate. Below this is reddish-yellow clay loam that is about 10 percent calcium carbonate and extends to a depth of 84 inches (fig. 10).

Olton soils are well drained. Runoff is very slow to slow, and permeability is moderately slow. Available water capacity is high.

These soils are used mainly for crops. Most areas are irrigated, but a few areas are dryfarmed. A few areas are in native vegetation and are used as range.

Representative profile of Olton clay loam, 1 to 3 percent slopes, 1.7 miles west on county road from post office in Aiken, then 0.7 mile south on a county road and 200 feet west of the road, in a cultivated field:

Ap—0 to 9 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; weak, fine and medium, granular structure; hard, firm; mildly alkaline; abrupt, smooth boundary.

B21t—9 to 17 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate, fine and medium, subangular blocky structure; very hard, firm; few fine pores; few worm casts; thin clay films on faces of peds; mildly alkaline; gradual, smooth boundary.

B22t—17 to 31 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate, medium, blocky structure; very hard, firm; few fine pores; thin clay films; calcareous; moderately alkaline; gradual, smooth boundary.

B23tca—31 to 44 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak to moderate, medium, subangular blocky structure; hard, firm; few fine pores; thin clay films; few films, threads, and small concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B24tca—44 to 72 inches, pink (5YR 8/4) clay loam, light reddish brown (5YR 6/4) moist; weak, medium, subangular blocky structure; hard, firm; about 40 percent, by volume, soft chalky calcium carbonate; few small concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

B25tca—72 to 84 inches, reddish-yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak to moderate, medium, subangular blocky structure; hard, firm; patchy clay films; about 10 percent, by volume, films, threads, and small concretions of calcium carbonate; calcareous; moderately alkaline.

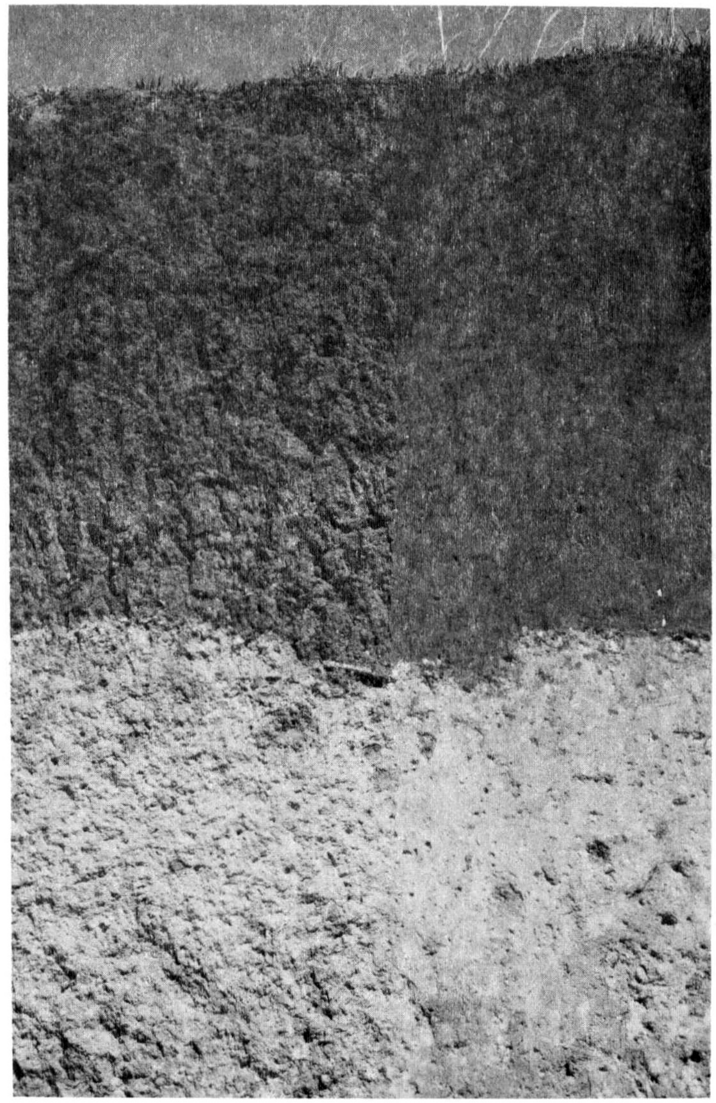

*Figure 10.*—**Profile of Olton clay loam showing distinct layer of calcium carbonate.**

The A horizon is 6 to 12 inches thick. It is reddish brown, brown, or dark brown and is neutral or mildly alkaline. The dark colored upper portion ranges from 11 to 20 inches in thickness. The B2t horizon is reddish-brown, brown, or yellowish-red clay loam to clay. It is mildly alkaline or moderately alkaline. The B2tca horizon is at a depth of 30 to 60 inches, but it is mostly at a depth of 32 to 43 inches. The B23tca horizon and the B24tca horizon is yellowish red, reddish yellow, pink, and light reddish brown. The horizons are about 20 to 60 percent, by volume, films,

threads, soft masses, and hard concretions of calcium carbonate. The B25tca horizon is reddish yellow or red. It is 10 to 30 percent, by volume, calcium carbonate.

**Olton clay loam, 0 to 1 percent slopes** (OtA).—This nearly level soil is on uplands. Areas are irregular in shape and are 8 acres to several hundred acres in size. Slopes average about 0.3 percent.

The surface layer is dark-brown clay loam about 8 inches thick. The next 8 inches is brown, firm clay loam over about 12 inches of reddish-brown, firm clay. The next layer is yellowish-red, firm, calcareous clay that is about 10 inches thick. Below this is about 30 inches of reddish-yellow clay loam that is about 40 percent calcium carbonate. The next layer to a depth of 84 inches is reddish-yellow clay loam that is about 10 percent calcium carbonate.

Included with this soil in mapping are small areas of Lofton soils that are in slight depressions and are less than 5 acres in size. Also included are narrow areas of Amarillo, Estacado, Mansker and Pullman soils that are less than 5 acres in size and a few areas of Olton soils that have slopes of 1 to 3 percent and are too small to be mapped separately. A few areas of soils that have less than 15 percent calcium carbonate in the layer of calcium carbonate accumulation are included. About 10 percent of the soils in the mapping unit are leached free of carbonates to a depth of more than 28 inches. Soils in areas that border Pullman soils are dark colored to a depth of more than 20 inches.

This Olton soil is used mostly for crops. Most cultivated areas are irrigated, but a few areas are dryfarmed. Cotton, grain sorghum, soybeans, and wheat are the main crops. The main concerns in management are maintaining tilth, controlling erosion, and conserving moisture. Runoff is slow. The hazards of soil blowing and erosion are slight.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth, control soil blowing and erosion, and conserve moisture. An example of a suitable cropping system is cotton followed by grain sorghum, wheat, or some other high-residue crop every other year.

In areas where this soil is irrigated, a properly designed irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces, terracing, contour farming, and land leveling help to control erosion and conserve moisture in some areas. Capability unit IIIe–5, dryland, and IIe–1, irrigated; Clay Loam range site.

**Olton clay loam, 1 to 3 percent slopes** (OtB).—This gently sloping soil is on uplands. Areas are irregular in shape and are mostly 5 to 100 acres in size. In some places areas are longer than they are wide and follow the slope contours above drainageways and playa basins. This soil has the profile described as representative of the series.

Included with this soil in mapping are some areas of Estacado, Mansker, and Pullman soils that are less than 5 acres in size. Olton soil, 0 to 1 percent slopes, is included in areas on flat ridgetops or near drainageways. A few shallow gullies are included in some unprotected cultivated areas. The gullies are more than 300 feet apart, and they can be crossed by farm machinery. Also included are some areas of soils that are less than 15 percent calcium carbonate, a few areas of soils that are leached free of carbonates to a depth of more than 28 inches, and some areas of soils that are dark colored to a depth of more than 20 inches.

This Olton soil is used mostly for crops, but a few areas are used as range. Many areas are irrigated. Cotton, grain sorghum, soybeans, and wheat are the main crops. The main concerns in management are maintaining tilth, controlling erosion, and conserving moisture. Runoff is slow. The hazard of soil blowing is slight, and the hazard of erosion is moderate.

Using crops in the cropping system that produce a large amount of crop residue and leaving the residue on the surface help to maintain tilth, control soil blowing and erosion, and conserve moisture. An example of a suitable cropping system is cotton followed by grain sorghum, wheat, or some other high-residue crop every other year.

In areas where this soil is irrigated, a properly designed irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces, terracing, contour farming, and land leveling help to control erosion and conserve moisture. Capability unit IIIe–2, dryland, and IIIe–2, irrigated; Clay Loam range site.

## Paloduro Series

The Paloduro series consists of deep, nearly level to steep, loamy soils on uplands. These soils formed in loamy calcareous material.

In a representative profile the surface layer is brown, calcareous loam about 15 inches thick. The next layer is about 40 inches of brown, calcareous loam that has films and threads of calcium carbonate. It has many worm casts in the upper part. Below this is light-brown, calcareous fine sandy loam that extends to a depth of 64 inches.

Paloduro soils are well drained. Runoff is medium, and permeability is moderate. Available water capacity is high.

Soils in nearly level areas are used for crops. Soils in more sloping areas are used as range.

Representative profile of Paloduro loam, 0 to 1 percent slopes, 11.8 miles east and northeast of Cedar Hill on Farm Road 97 and 150 feet north of the road, in a cultivated field:

Ap—0 to 8 inches, brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak, fine, granular structure; slightly hard, friable; calcareous; moderately alkaline; abrupt, smooth boundary.

A1—8 to 15 inches, brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak, fine, granular structure and weak, medium, subangular blocky structure; slightly hard, friable; few worm casts; calcareous; moderately alkaline; clear, smooth boundary.

B21—15 to 35 inches, brown (7.5YR 4/4) loam, brown (7.5YR 4/4) moist; weak, coarse, prismatic structure parting to moderate, fine, granular and weak, fine, subangular blocky; slightly hard, friable; few fine pores; many worm casts; visible films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B22—35 to 55 inches, brown (7.5YR 5/4) loam, brown (7.5YR 4/4) moist; weak, coarse, prismatic structure parting to weak, fine, subangular blocky; slightly hard, friable; visible films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B23—55 to 64 inches, light-brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak, coarse, prismatic structure; slightly hard, very friable; few visible films and threads of calcium carbonate; calcareous; moderately alkaline.

The A horizon is 10 to 20 inches thick and is brown or dark brown. The B2 horizon is reddish-brown, brown, and light-brown loam to sandy clay loam. Calcium carbonate ranges from a few films, threads, and concretions to as much as 10 percent, by volume. In some areas buried layers of different texture and different colors are at a depth of more than 40 inches.

**Paloduro loam, 0 to 1 percent slopes (PaA).**—This nearly level soil is on broad plains on uplands. Areas are 10 acres to as large as 400 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are some areas of Amarillo, Berda, Flomot, and Mobeetie soils. Also included are some areas of soils that have a surface layer of fine sandy loam 6 to 14 inches thick. Some areas of soils that have a dark-colored surface layer to a depth of more than 20 inches are also included.

This Paloduro soil is used mostly for crops. A few areas are irrigated. The rest is used as range. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are maintaining tilth, controlling soil blowing, and conserving moisture. The hazard of soil blowing is moderate, and the hazard of erosion is slight.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth, prevent soil blowing, and conserve moisture. An example of a suitable cropping system is cotton followed by grain sorghum, wheat, or some other high-residue crop for 2 years.

In areas where this soil is irrigated, a properly designed sprinkler irrigation system is needed to provide adequate water for crops and prevent soil and water losses. Using diversion terraces, terracing, and contour farming help to control erosion. Capability unit IIIe–3, dryland and, IIe–2, irrigated; Hardland Slopes range site.

## Polar Series

The Polar series consists of deep, gently sloping to steep, gravelly loamy soils on uplands. These soils formed in deposits of intermingled gravel and finer materials that were laid down by water.

In a representative profile the surface layer is about 8 inches of brown, calcareous, gravelly sandy loam that is about 40 percent gravel. The next layer is about 19 inches of light-brown very gravelly sandy loam that is about 70 percent gravel and 15 percent calcium carbonate. The underlying material to a depth of 60 inches is light-brown, calcareous, very gravelly loamy sand that is 70 percent gravel and has a few coatings of calcium carbonate (fig. 11).

Polar soils are excessively drained. Runoff is medium to rapid, depending on the gradient. Permeability is moderately rapid, and available water capacity is low.

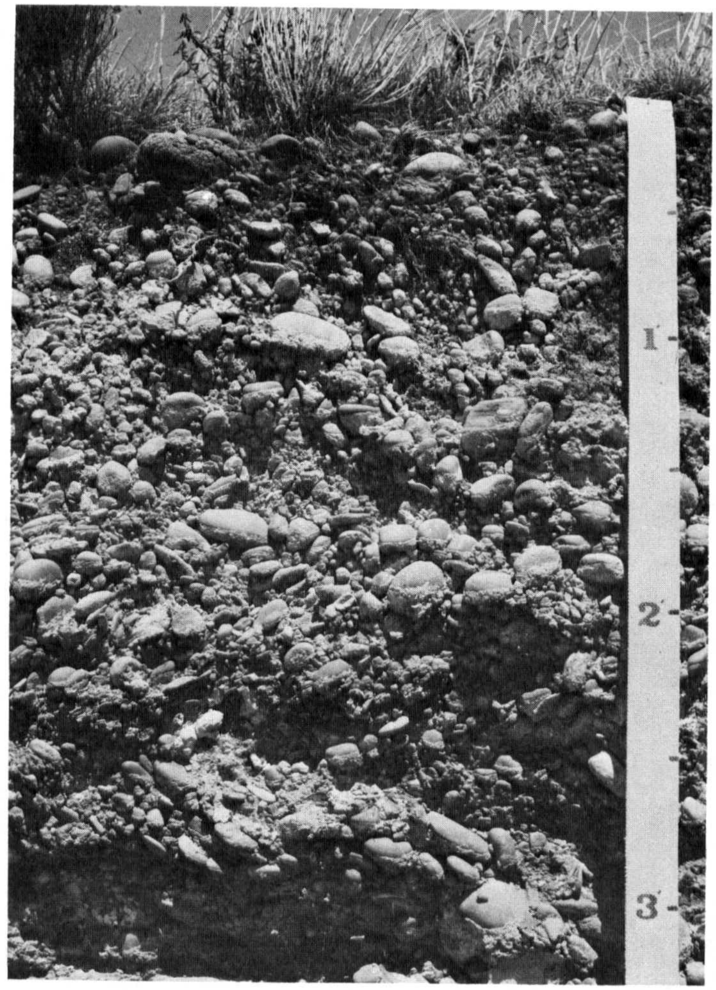

*Figure 11.*—**Profile of Polar gravelly sandy loam showing caliche-coated gravel.**

These soils are used as range and wildlife habitat. Some areas are excellent sources of gravel and sand and are being mined.

Representative profile of Polar gravelly sandy loam in an area of Polar and Paloduro soils, 3 to 30 percent slopes, 14 miles east of Floydada on U.S. Highway 62 and 70, then 5 miles north on Farm Road 28, then 1.6 miles northeast on a county road, then 3 miles north, 1 mile west, and 1.25 miles northwest on a ranch road, then 0.35 mile south of the road, in range:

A1—0 to 8 inches, brown (7.5YR 5/4) gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak, granular structure; slightly hard, very friable; few roots; 40 percent, by volume, gravel; calcium carbonate coatings on lower surfaces of most pebbles; calcareous; moderately alkaline; clear, wavy boundary.

Cca—8 to 27 inches, light-brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; massive; hard, firm; few roots; 65 to 70 percent, by volume, gravel; calcium carbonate coating on most pebbles; pebbles in upper part weakly cemented with calcium carbonate; about 15 percent, by volume, calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

C—27 to 60 inches, light-brown (7.5YR 6/4) very gravelly loamy sand, brown (7.5YR 5/4) moist; massive; soft, very friable; 70 percent, by volume, gravel; coatings of calcium carbonate on some pebbles; calcareous; moderately alkaline.

The A1 horizon is 5 to 14 inches thick. It is reddish-brown, brown, or light-brown gravelly sandy loam to gravelly sandy clay loam. In some places this horizon is less than 7 inches thick and is darker in color. At a depth of 10 to 40 inches, rounded gravel 2 millimeters to 10 centimeters in diameter make up 35 to 70 percent of the horizon. The C horizon is light reddish brown, light brown, reddish brown, or brown. It is mostly very gravelly sandy loam but ranges to very gravelly sandy clay loam. In some places the upper part of this horizon is 15 percent to as much as 40 percent calcium carbonate, which is at least 5 percent more than the lower part of the horizon.

**Polar and Paloduro soils, 3 to 30 percent slopes (PdG).**—This mapping unit is made up of gently sloping to steep soils on an irregular series of small hills that have rounded convex crests (fig. 12). It is 65 percent Polar soils, 20 percent Paloduro soils, and 15 percent Berda, Bippus, and Mobeetie soils. These soils are so intricately intermingled that it is not practical to separate them at the scale used in mapping. Areas are irregular in shape and are 30 to 400 acres in size.

The Polar soils are on side slopes and on the top of knolls and hills. A Polar soil in this unit has the profile described as representative of the series.

The Paloduro soils are in concave-shaped valleys between knolls. Most areas are less than 100 feet across and have a small drainageway on the bottom. These soils have a surface layer of dark-brown, calcareous loam about 12 inches thick. The next layer is about 19 inches of brown, calcareous loam that has many films and threads of calcium carbonate. Below this is light-brown, calcareous loam that extends to a depth of 60 inches.

The soils in this mapping unit are used as range and wildlife habitat. Some areas are mined for gravel and sand. The main concerns in management are conserving moisture and controlling erosion. The hazard of soil blowing is slight, and the hazard of erosion is moderate.

Providing for planned periods of deferred grazing to allow a vigorous growth of grass and maintaining a minimum of 50 percent of a season's growth of grass help to control erosion and conserve moisture. In some areas controlling brush by chemical or mechanical methods helps to conserve moisture. A brush-control program should allow for planned areas of wildlife habitat. Capability unit VIs–1, dryland; Gravelly range site.

*Figure 12.*—**Area of Polar and Paloduro soils, 3 to 30 percent slopes.**

## Portales Series

The Portales series consists of deep, nearly level, loamy soils on uplands. These soils are in areas in and around playa lake depressions and in some isolated areas on the bottom of draws. They formed in loamy, calcareous material.

In a representative profile the surface layer is grayish-brown, calcareous loam about 12 inches thick. Below this is about 15 inches of grayish-brown, calcareous loam that has common worm casts. The next layer is about 24 inches of very pale brown clay loam that is about 20 percent calcium carbonate. The underlying material is very pale brown, calcareous sandy clay loam that extends to a depth of 64 inches.

Portales soils are well drained. Runoff is very slow, and permeability is moderate. Available water capacity is high.

These soils are used mostly for crops. A few cultivated areas are irrigated. Some areas are in native vegetation and are used as range. In some places the high lime content in the soils causes a deficiency of plant nutrients in some crops.

Representative profile of Portales loam, 0 to 1 percent slopes, 1.5 miles west of Barwise on Farm Road 784, then 4.3 miles north on a county road, then 0.6 mile east on a second county road, then 0.2 mile north on another county road and 500 feet east of the road, in a cultivated field:

Ap—0 to 12 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; soft, friable; lime disseminated; calcareous; moderately alkaline; abrupt, smooth boundary.

B2—12 to 27 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; compound weak, medium, granular structure and weak, medium, subangular blocky structure; slightly hard, friable; few roots; common fine pores; common worm casts; calcareous; moderately alkaline; clear, smooth boundary.

B2ca—27 to 51 inches, very pale brown (10YR 8/3) clay loam, pale brown (10YR 6/3) moist; weak, medium, subangular blocky structure; slightly hard, friable; few pores; few worm casts; about 20 percent, by volume, soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, irregular boundary.

C—51 to 64 inches, very pale brown (10YR 8/4) sandy clay loam, very pale brown (10YR 7/4) moist; massive; slightly hard, friable; few visible soft concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon is 10 to 14 inches thick. It is brown, dark brown, grayish brown, and dark grayish brown. The B2 horizon is brown, grayish-brown, light brownish-gray, very pale brown, pale-brown, and light-brown clay loam to loam. It has a few films and threads of calcium carbonate in the upper part and is 15 to 35 percent calcium carbonate in the lower part. The Bca horizon is at a depth of 20 to 35 inches. The C horizon is pink, pinkish-gray, very pale brown, light-gray, and pale-brown clay loam to sandy clay loam.

**Portales loam, 0 to 1 percent slopes** (PmA).—This nearly level soil is mostly in playa basins. Areas are dominantly less than 40 acres in size, but several are more than 100 acres in size.

Included with this soil in mapping are a few small areas of Drake and Estacado soils and some areas of a soil that is similar to Portales soil but that has a lighter colored surface layer. In some areas this soil makes up as much as 30 percent of a mapped area. Also included are a few isolated areas of soils that are fine sandy loam and a few areas of soils that have a surface layer leached free of carbonates and have no layer of calcium carbonate accumulation.

This Portales soil is used mostly for crops. Most cultivated areas are irrigated, but a few are dry-farmed. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are controlling soil blowing and conserving moisture. Runoff is very slow. The hazard of soil blowing is moderate, and the hazard of erosion is slight.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to control soil blowing and conserve moisture. An example of a suitable cropping system is cotton followed by grain sorghum, wheat, or some other high-residue crop every other year.

In areas where this soil is irrigated, a properly designed irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. The use of fertilizer and some trace elements in some areas helps to overcome plant nutrient deficiencies. Capability unit IIIe–5, dryland, and IIe–2, irrigated; Hardland Slopes range site.

## Posey Series

The Posey series consists of deep, sloping to strongly sloping, loamy soils on uplands. These soils formed in loamy calcareous material mostly of eolian origin.

In a representative profile the surface layer is brown, calcareous loam about 8 inches thick. The next layer is about 22 inches of yellowish-red clay loam that is about 20 percent calcium carbonate. Below this is about 30 inches of reddish-yellow clay loam that is 25 percent calcium carbonate. The next layer to a depth of 80 inches is yellowish-red clay loam that is about 35 percent calcium carbonate.

Posey soils are well drained. Runoff is medium, and permeability is moderate. Available water capacity is medium.

These soils are used as range.

Representative profile of Posey loam in an area of Posey and Tulia soils, 5 to 12 percent slopes, 7.2 miles south on U.S. Highway 62 from its intersection with U.S. Highway 62 and 70 in Floydada and 400 feet west of the highway, in range:

A1—0 to 8 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak, fine and medium, granular structure; slightly hard, friable; few roots; few strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B21tca—8 to 30 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm; few roots; few pores; few worm casts; patchy clay films; about 20 percent, by volume, cemented concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B22tca—30 to 60 inches, reddish-yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm; common fine root channels; few worm casts; patchy clay films; about 25 percent, by volume, weakly cemented concretions; soft masses and films of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B23tca—60 to 80 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm; few fine pores; patchy clay films; about 35 percent, by volume, cemented concretions and soft masses of calcium carbonate; few, cemented, vertical stringers of calcium carbonate; calcareous; moderately alkaline.

The A1 horizon is 5 to 12 inches thick and is reddish brown or brown. It is mainly loam but ranges to fine sandy loam. The Bt horizon extends to a depth of 60 inches to more than 80 inches. It is light-red, reddish-yellow, or yellowish-red sandy clay loam to clay loam. This horizon is 10 to 35 percent, by volume, calcium carbonate.

**Posey and Tulia soils, 5 to 12 percent slopes (PsD).**—This mapping unit is made up of sloping to strongly sloping soils on uplands immediately above the Caprock Escarpment (fig. 13). It is about 52 percent Posey soils, 22 percent Tulia soils, 11 percent Mansker soils, and 15 percent other soils. Areas are irregular in shape, are 10 to 150 acres or more in size, and range from a few hundred yards to 0.2 mile wide and as much as 1 mile or more long. Most areas follow the margin of the High Plains. The soils are in irregular patterns and are so intricately intermingled that it is not practical to separate them at the scale used in mapping. Both soils formed in the same materials.

Included with these soils in mapping are areas of Estacado, Olton, Potter, and Pullman soils. Also included are areas of soils that have slopes as much as 20 percent.

These soils are used as range and wildlife habitat. The main concerns in management are controlling erosion and conserving moisture. Runoff is slow to rapid. The hazard of soil blowing is slight, and the hazard of erosion is severe.

Providing for planned periods of deferred grazing to allow a vigorous growth of grass and maintaining a minimum of 50 percent of a season's growth of grass help to control erosion and conserve moisture. In some areas controlling brush by chemical or mechanical methods helps to conserve moisture. A brush-control program should allow for planned areas of wildlife habitat. Capability unit VIe–2, dryland; Hardland Slopes range site.

## Potter Series

The Potter series consists of shallow to very shallow, gently sloping to moderately steep, loamy soils on up-

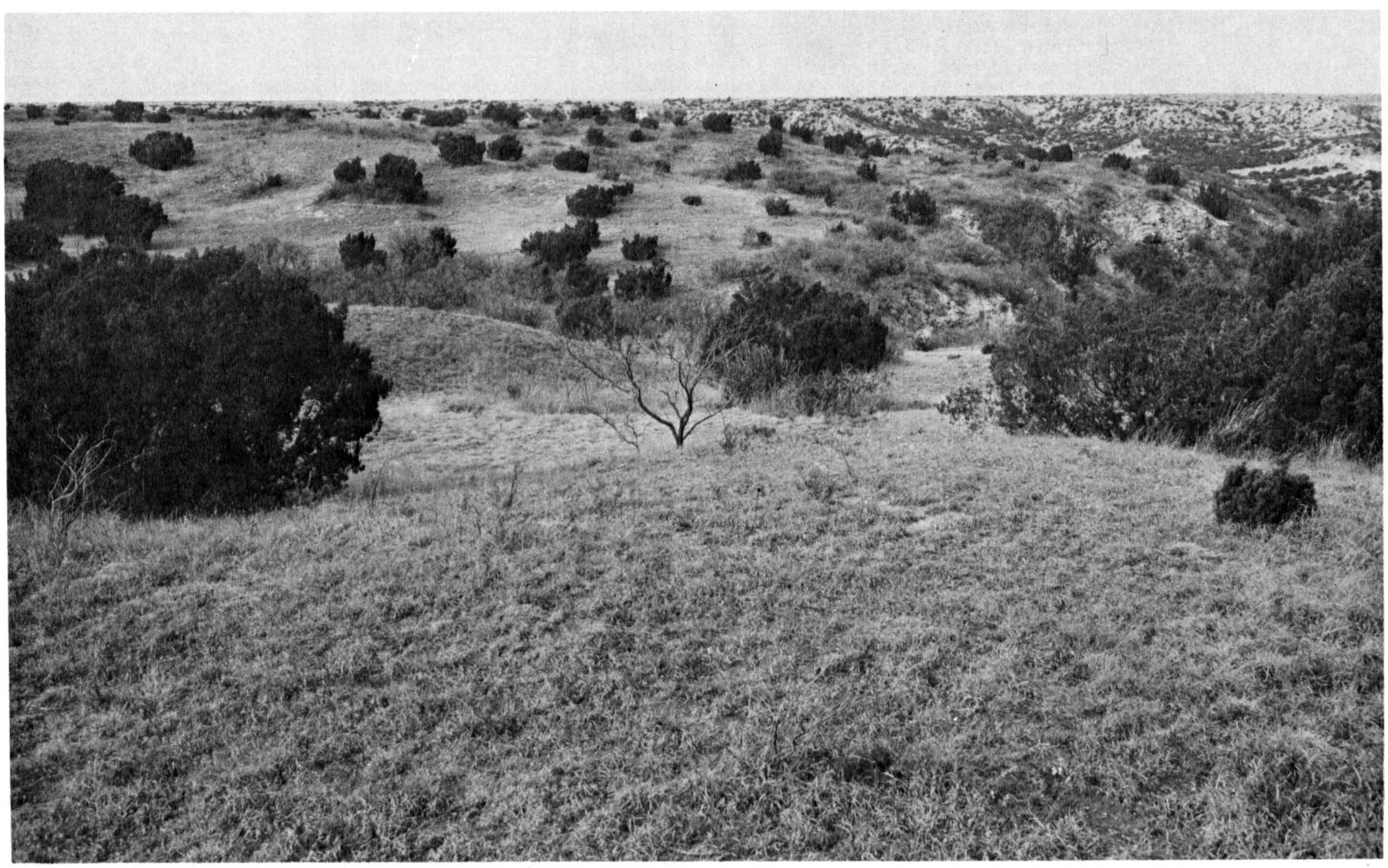

*Figure 13.*—**Area of Posey and Tulia soils, 5 to 12 percent slopes.**

lands. These soils formed in caliche beds of different thicknesses. In some places surface layers formed in material laid down by water.

In a representative profile the surface layer is about 6 inches of brown loam that is about 15 percent calcium carbonate fragments. The underlying material is white caliche that extends to a depth of 25 inches (fig. 14).

Potter soils are well drained. Runoff is medium to rapid, and permeability is moderate. Available water capacity is very low.

These soils are used as range and wildlife habitat. A few areas are mined for caliche, which is used as roadbase material.

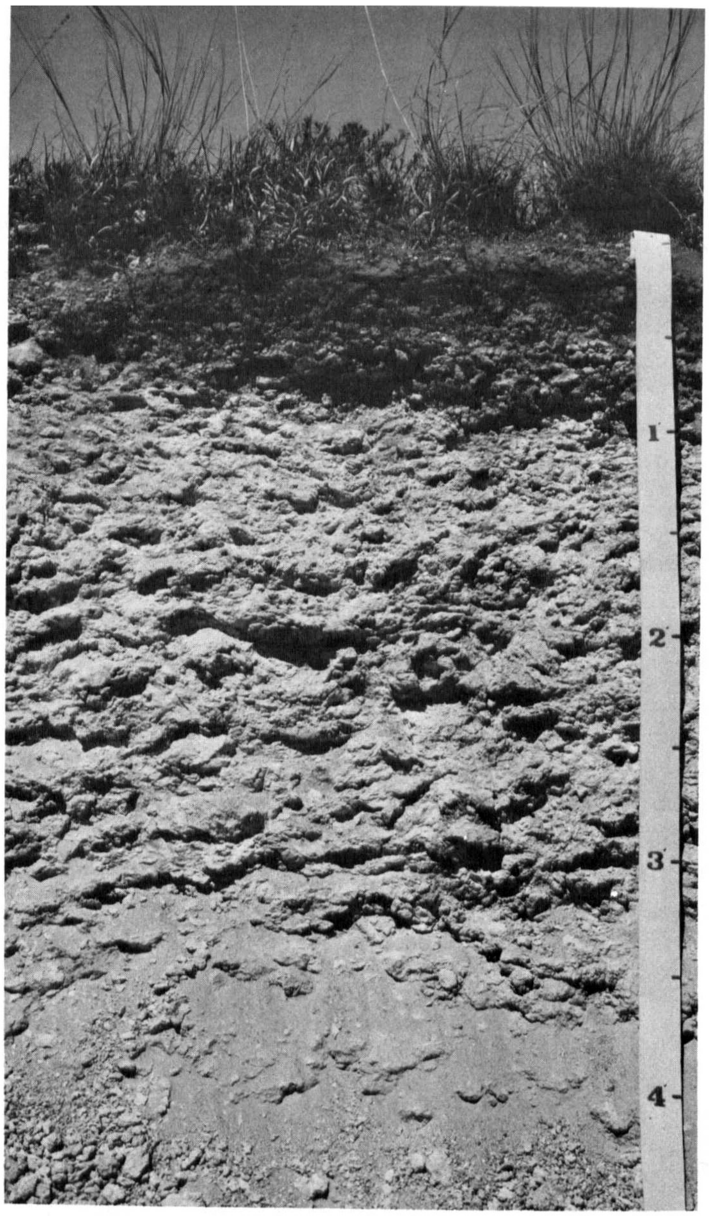

*Figure 14.*—**Profile of Potter loam showing thin surface layer over caliche.**

Representative profile of Potter loam in an area of Potter soils, 2 to 20 percent slopes, 3 miles east of Cedar Hill on Farm Road 97, 1 mile east on county road, then 1 mile south on a county road and 650 feet east of the road, in range:

A1—0 to 6 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak, medium, subangular; blocky structure and medium, fine, granular structure; slightly hard, friable; many roots; many worm casts; about 15 percent, by volume, calcium carbonate fragments as much as 2 inches in diameter; calcareous; moderately alkaline; clear, smooth boundary.

Cca—6 to 25 inches, white (10YR 8/2) about 70 percent caliche fragments 1 inch to 5 inches in size with a hardness of less than 3 on Mohs scale; about 30 percent, by volume, soft powdery caliche and loamy material.

The A1 horizon is 4 to 12 inches thick and is light brown, brown, or grayish brown. It is mainly loam but ranges to clay loam. The Cca horizon is mainly platy caliche that has a hardness of slightly less than 3 on Mohs scale. It has soft caliche beds intermingled with pockets of pinkish loamy earth.

**Potter soils, 2 to 20 percent slopes (PtE).**—These gently sloping to moderately steep soils are mostly on convex hills and side slopes (fig. 15). Most areas are on thin bands mainly 300 to 400 feet wide and 0.2 to 0.7 mile long around the margin of larger playa lakes and along the Caprock Escarpment. A soil in this unit has the profile described as representative of the series.

Included with these soils in mapping are areas of Mansker, Posey, and Tulia soils and some areas of soils that have a surface layer less than 4 inches thick and have exposed caliche beds barren of vegetation. Also included are some areas of soils that have caliche beds less than 12 inches thick and are underlain by sandy clay loam material of the Ogallala Formation.

These Potter soils are used as range and wildlife habitat. A few areas are mined for roadbed material. The main concerns in management are controlling erosion and conserving moisture. Runoff is medium to rapid. Because little water enters the soil, it is droughty. The hazard of soil blowing is slight, and the hazard of erosion is severe.

Maintaining a minimum of 50 percent of a season's growth of grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass help to control erosion and conserve moisture. Capability unit VIIs–1, dryland; Very Shallow range site.

## Pullman Series

The Pullman series consists of deep, nearly level to gently sloping, loamy soils on uplands. These soils formed in clayey to loamy, eolian materials that were deposited in successive layers. The intervening periods between deposition of the layers was long enough for soil-forming processes to operate.

In a representative profile the surface layer is brown clay loam about 8 inches thick. The next layer is brown clay about 25 inches thick. It is noncalcareous in the upper part and calcareous in the lower part. Below this is 13 inches of reddish-brown, calcareous clay over about 9 inches of yellowish-red, calcareous clay loam.

*Figure 15.*—**Area of Potter soils, 2 to 20 percent slopes.**

The next layer is about 17 inches of pink clay loam that is about 50 percent calcium carbonate. Below this to a depth of 86 inches is reddish-yellow clay loam that is about 20 percent calcium carbonate (fig. 16).

Pullman soils are well drained. Runoff is slow, and permeability is very slow. Available water capacity is medium.

These soils are used mainly for irrigated crops. Some areas are dryfarmed. A few areas are in native vegetation and are used as range.

Representative profile of Pullman clay loam, 0 to 1 percent slopes, 0.5 mile south and 2.5 miles east of the county courthouse in Floydada on U.S. Highway 62 and 70, then 0.5 mile north on a county road and 100 feet west of the road, in a cultivated field:

Ap—0 to 8 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak, fine, granular structure; hard, friable; mildly alkaline; clear, smooth boundary.

B21t—8 to 14 inches, brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate, medium, blocky structure parting to fine and very fine, irregular, blocky; hard, firm; few roots; continuous clay films on faces of peds; some pressure faces tilted 15 degrees from the horizontal; mildly alkaline; clear, smooth boundary.

B22t—14 to 25 inches, brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate, medium, blocky structure parting to fine and very fine, irregular, blocky; extremely hard, very firm; few root channels; few short slickensides; peds tilted 15 degrees from the horizontal; continuous clay films on peds; mildly alkaline; gradual, wavy boundary.

B23t—25 to 33 inches, brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; moderate, medium, blocky structure; very hard, firm; few fine pores and old root channels; clay films on faces of peds; few films and fine soft masses of calcium carbonate; vertical lenses of surface material in cracks ⅛ to ½ inch wide; calcareous; moderately alkaline; gradual, wavy boundary.

B24t—33 to 46 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate, medium, blocky structure; hard, firm; common root channels and few fine pores; clay films on faces of peds; vertical lenses of surface material in cracks; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B25t—46 to 55 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 5/6) moist; weak, medium, blocky structure; hard, firm; many old root channels, few fine pores; clay films on faces of peds; many films and threads of calcium carbonate; calcareous; moderately alkaline; abrupt, wavy boundary.

B26tca—55 to 72 inches, pink (5YR 8/4) clay loam, light reddish brown (5YR 6/4) moist; weak, medium, subangular blocky structure; hard, friable; 50 percent, by volume, calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B27tca—72 to 86 inches, reddish-yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak, subangular blocky structure; hard, friable; clay films on faces of peds; about 20 percent, by volume, calcium carbonate; calcareous; moderately alkaline.

The A horizon is 5 to 12 inches thick. It is dark grayish brown and brown and is neutral to moderately alkaline. The upper part of the B2t horizon is clay that has a clay content of 40 to 50 percent. The B21t horizon and the B22t horizon are brown, grayish brown, and dark grayish brown. The B23t horizon and the B24t horizon are reddish brown, brown, and yellowish brown. The B25t horizon is reddish brown or yellowish red. The B2tca horizon is at a depth of 30 to 60 inches. This horizon is mainly clay loam but ranges

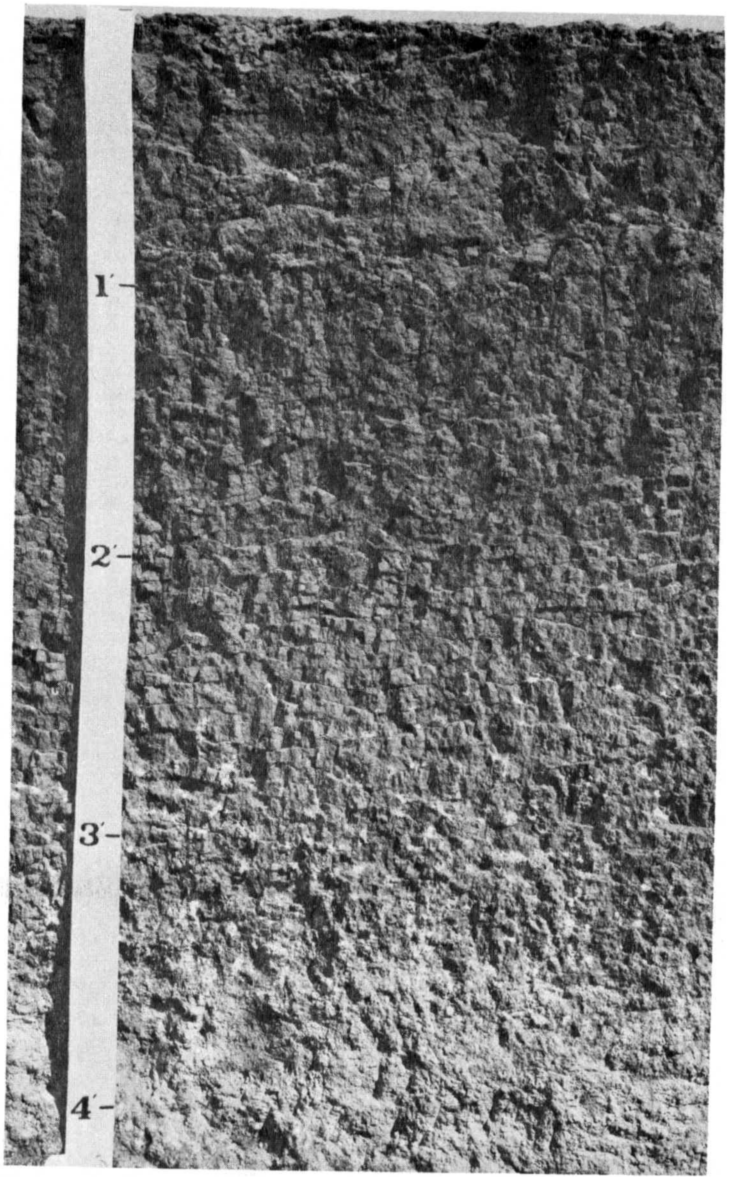


***Figure 16.*—Profile of Pullman clay loam showing blocky structure.**

to silty clay loam. It is pink, reddish yellow, yellowish red, and brown and is 20 to 70 percent, by volume, calcium carbonate.

**Pullman clay loam, 0 to 1 percent slopes** (PuA).—This nearly level soil is in continuous areas that are thousands of acres in size and are interrupted only by playa depressions. Slopes average about 0.3 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are some areas of Lofton soils in slight depressions less than 5 acres in size and areas of Mansker soils on narrow bands around playa lakes. Also included are small areas of Olton soils; a few areas of Pullman clay loam, 1 to 3 percent slopes; and many small areas of Randall soils in depressions less than 2 acres in size. Some areas of soils that border Olton soils and are dark colored to a depth of less than 20 inches are also included.

This Pullman soil is used mostly for crops. Most cultivated areas are irrigated, but a few areas are dryfarmed. Cotton, grain sorghum, soybeans, vegetables, and wheat are the main crops. The main concerns in management are maintaining tilth, controlling erosion, and conserving moisture. Runoff is slow. The hazards of soil blowing and erosion are slight.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth, prevent soil blowing, and conserve moisture. Avoiding tillage operations when the soil is wet helps to maintain tilth. An example of a suitable cropping system is cotton followed by grain sorghum, wheat, or some other high-residue crop every other year.

In areas where this soil is irrigated, a properly designed surface irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Capability unit IIIe–4, dryland, and IIs–1, irrigated; Clay Loam range site.

**Pullman clay loam, 1 to 3 percent slopes** (PuB).—This gently sloping soil is in narrow areas that border playa depressions and drainageways. Most areas are small in size, but some are as large as 200 acres. Slopes are dominantly 1 to 2 percent.

The surface layer is brown clay loam about 5 inches thick. The next layer is about 22 inches of brown clay that is noncalcareous in the upper part and calcareous in the lower part. Below this is calcareous clay about 17 inches thick. It is reddish brown in the upper part and yellowish red in the lower part. The next layer is about 24 inches of reddish-yellow clay loam that is about 50 percent calcium carbonate. Below this to a depth of 84 inches is reddish-yellow clay loam that is about 20 percent calcium carbonate.

Included with this soil in mapping are small areas of Estacado and Mansker soils; a few areas of Pullman clay loam, 0 to 1 percent slopes; and small outcrops of Olton soils mostly no more than 5 acres in size. Also included are eroded soils in cultivated areas. In eroded areas the surface layer has been thinned, and in some places the plow layer incorporates material from the subsoil and therefore is clay. In other places the soil is dark colored to a depth of less than 20 inches.

This Pullman soil is used mostly for crops. Some cultivated areas are irrigated. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are maintaining tilth, controlling erosion, and conserving moisture. Runoff is slow. The hazard of soil blowing is slight, and the hazard of erosion is moderate.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth, prevent soil blowing, and conserve moisture. Avoiding tillage operations when the soil is wet helps to maintain tilth. An example of a suitable cropping system is cotton followed by grain sorghum, wheat, or some other high-residue crop every other year.

In areas where the soil is irrigated, a properly de-

signed irrigation system is needed to provide adequate water for crops and to prevent soil and water losses. Using diversion terraces and grassed waterways, terracing, and contour farming help to control erosion and conserve moisture. Capability unit IIIe-1, dryland, and IIIe-1, irrigated; Clay Loam range site.

## Quinlan Series

The Quinlan series consists of shallow, sloping to strongly sloping, loamy soils on uplands. These soils formed in loamy, calcareous material that weathered from weakly consolidated sandstone.

In a representative profile the surface layer is reddish-brown, calcareous loam about 6 inches thick. The next layer is red, calcareous loam about 12 inches thick. The underlying material is red, weakly cemented, calcareous sandstone that extends to a depth of 60 inches.

Quinlan soils are well drained. Runoff is medium to rapid, and permeability is moderately rapid. Available water capacity is low.

These soils are used as range and wildlife habitat.

In Floyd County, Quinlan soils are mapped only with Obaro soils.

Representative profile of Quinlan loam in an area of Obaro and Quinlan soils, 5 to 12 percent slopes, 11.4 miles east and northeast of Cedar Hill on Farm Road 97 and 50 feet north of the road, in range:

A1—0 to 6 inches, reddish-brown (2.5YR 5/4) loam, dark reddish brown (2.5YR 3/4) moist; weak, medium, granular structure; slightly hard, friable; many roots; calcareous; moderately alkaline; gradual, wavy boundary.

B2—6 to 18 inches, red (2.5YR 5/6) loam, dark red (2.5YR 3/6) moist; weak, medium, granular structure; slightly hard, friable; many roots; few sandstone fragments; calcareous; moderately alkaline; gradual, wavy boundary.

C—18 to 60 inches, red (2.5YR 5/6), weakly cemented, calcareous sandstone, dark red (2.5YR 3/6) moist.

The solum ranges from 10 to 20 inches in thickness. The A1 horizon is reddish brown, yellowish red, and red and ranges from loam to silt loam and very fine sandy loam. The B2 horizon is reddish brown, reddish yellow, yellowish red, red, and light red. It is mainly loam but ranges to silt loam and very fine sandy loam and has bits of sandstone and in some areas a few calcium carbonate concretions. The C horizon is weakly cemented sandstone or siltstone. Blue-green splotches and strata range from none to as much as 50 percent of the parent material.

## Randall Series

The Randall series consists of deep, nearly level, calcareous, clayey soils on uplands. These soils are in areas that are on the bottom of playa lake depressions. Gilgai microrelief is in most soil areas. The soils formed in clayey calcareous material.

In a representative profile the surface layer is 4 inches of gray clay over about 46 inches of very firm, dark-gray clay. The next layer is about 30 inches of firm, gray clay that has gray, dark-gray, light brownish-gray, and grayish-brown mottles. The underlying material to a depth of 100 inches is gray clay that has olive mottles (fig. 17).


*Figure 17.*—**Profile of Randall clay showing slickensides and tilted, blocky structure.**

Randall soils are somewhat poorly drained. Permeability is very slow, and available water capacity is high. These soils take in water rapidly when they are dry and cracked and very slowly when they are wet. Excess water stands until it evaporates.

These soils are used mostly as range and wildlife habitat. Duck and geese are in many areas. Some areas are idle, and a few areas are cultivated where drainage is possible.

Representative profile of Randall clay, 0.5 mile east and 4.8 miles north of the county courthouse in Floydada on Texas Highway 207, then 350 feet east of the highway, in range:

A11—0 to 4 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate, fine, granular structure; hard, friable, sticky and plastic; many fine roots; mildly alkaline; clear, wavy boundary.

A12—4 to 20 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate, medium, angu-

lar blocky structure parting to very fine, angular blocky; few intersecting parallelepipeds about ½ inch to 1½ inches long; extremely hard, very firm, very sticky and very plastic; common fine roots through peds; mildly alkaline; diffuse, wavy boundary.

A13—20 to 50 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate, fine and medium, angular blocky structure; many parallelepipeds ½ to 1½ inches long tilted about 5 to 30 degrees from the horizontal, away from the center of the microdepression toward the microknoll; common slickensides that have angles as much as 30 degrees from the horizontal and as much as 3 feet across the long axis; very hard, very firm; few, fine, strongly cemented concretions of calcium carbonate; mildly alkaline; gradual, wavy boundary.

AC1—50 to 68 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; about 30 percent medium, faint and distinct mottles of gray (N 6/ ) and light brownish gray (2.5Y 6/2); moderate, fine and medium, angular blocky structure; many parallelepipeds tilted 30 to 70 degrees from the horizontal, much more prominent than in horizons above; common, large, intersecting slickensides; extremely hard, very firm, very sticky and very plastic; few roots that mainly follow the faces of slickensides and the faces of parallelepipeds; calcareous; moderately alkaline; gradual, wavy boundary.

AC2—68 to 80 inches, faintly to distinctly and coarsely mottled light brownish-gray (2.5Y 6/2) clay, grayish-brown (2.5Y 5/2) moist, and gray (N 5/ ) clay, dark gray (N 4/ ) moist; moderate, fine and medium, angular blocky structure; extremely hard, very firm, very sticky, and very plastic; common, large, intersecting slickensides; common, fine, strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C—80 to 100 inches, gray (N 6/ ) clay, gray (N 5/ ) moist; many, prominent, coarse, olive (5Y 5/6) mottles; few dark grayish-brown stains; few, fine, soft masses of calcium carbonate and few, fine, weakly and strongly cemented concretions of calcium carbonate.

When the soil is dry, cracks ¼ inch to 2 inches wide extend past a depth of 20 inches. The gilgai microrelief ranges from almost none in playa lakes that stay wet for a longer period of time than do most other areas to microhighs and microlows that are 5 to 15 feet apart. The microhighs are 2 to 10 inches higher than the microlows. The soil in microlows is noncalcareous to a greater depth than the soil in microhighs, which is mostly calcareous to the surface. The A1 horizon is 20 to 50 inches thick. It is gray, dark gray, and very dark gray and is neutral to moderately alkaline. In some areas an overburden of clay loam material ranges from 0 to 4 inches. Intersecting slickensides and parallelepipeds begin at a depth of 15 to 25 inches and extend to the C horizon. The AC horizon is 20 to 30 inches thick. It is gray or dark gray and is mildly alkaline or moderately alkaline. Calcium carbonate content ranges from none to a few small concretions. Depth to the C horizon ranges from 37 to 72 inches or more. This horizon is gray, light gray, or light brownish gray.

**Randall clay** (Ra).—This nearly level soil is in depressional areas of playa lakes throughout the county. The playa lakes number about 3 or 4 per square mile and are a few feet to 40 feet lower than the surrounding plain. Areas are round to oval in shape and are 3 to 320 acres in size. Because this clayey soil swells during wet periods and shrinks during dry periods, the surface is slightly undulating and has a gilgai microrelief. Microhighs and microlows are about 5 to 15 feet apart, and the microhighs are 2 to 10 inches higher than the microlows.

Included with this soil in mapping are small areas of Lofton soils that are adjacent to playa lakes. Also included are areas of Estacado and Mansker soils which surround smaller playa lakes.

This Randall clay is used mostly as range or wildlife habitat. Because this soil is in low areas, it receives runoff from soils in surrounding areas. Most areas are covered by water several weeks to several months each year. A few areas that have been drained are cultivated. Cotton, grain sorghum, and wheat are the main crops. The main concerns in management are maintaining tilth and controlling soil blowing. The hazard of soil blowing is moderate.

Using crops in the cropping system that produce a large amount of crop residue and leaving this residue on the surface help to maintain tilth and control soil blowing. This soil is mostly in small areas, and it is best to apply the same practices to this soil as to soils in adjoining areas. Avoiding tillage when the soil is wet helps to maintain tilth.

Terracing and contour farming of soils in adjoining areas help to control runoff of these soils and decrease the hazard of wetness of this soil. In undrained areas: Capability unit VIw–1, dryland; range site the same as that of adjacent soil. In drained areas: Capability unit IVs–1, dryland, and IVs–1, irrigated; range site the same as that of adjacent soil.

## Rock Outcrop

Rock outcrop consists mainly of exposed, strongly cemented sandstone or conglomerate rock that is mostly calcareous. It is mostly on strongly sloping to moderately steep escarpments. In places a thin layer of weathered soil material that is less than 4 inches thick is on the surface.

Vegetation is limited to a few juniper trees.

Rock outcrop in Floyd County is mapped only with Latom soils.

## Springer Series

The Springer series consists of deep, gently sloping to sloping, sandy soils on uplands in areas that are undulating to hummocky. These soils formed in sandy, unconsolidated, eolian material.

In a representative profile the surface layer is reddish-brown loamy fine sand about 13 inches thick. Below this is yellowish-red fine sandy loam about 35 inches thick. The next layer is yellowish-red loamy fine sand about 20 inches thick. The next layer is yellowish-red fine sandy loam in the upper part and yellowish-red loamy fine sand in the lower part and extends to a depth of 84 inches.

Springer soils are well drained. Runoff is slow, and permeability is moderately rapid. Available water capacity is very low.

These soils are used mostly as range. A few small areas are cultivated. Many areas that were once cultivated are now used as range.

Representative profile of Springer loamy fine sand, 3 to 8 percent slopes, 10.6 miles east and northeast of Cedar Hill on Farm Road 97, then 4.4 miles north on Farm Road 1065 and 100 feet east of the road, in range:

A1—0 to 13 inches, reddish-brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) moist; single grained; loose; many fine roots; neutral; clear, smooth boundary.

B2t—13 to 28 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak, coarse, prismatic structure and weak, medium, subangular blocky structure; slightly hard, very friable; many fine roots; bridging between sand grains; few pockets of sandy clay loam; mildly alkaline; gradual, smooth boundary.

B3—28 to 48 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak, coarse, prismatic structure; soft, very friable; few clean sand grains; pockets of sandy clay loam; noncalcareous; moderately alkaline; gradual, smooth boundary.

A′—48 to 68 inches, yellowish-red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; single grained; few pockets of clean sand grains; noncalcareous; moderately alkaline; gradual, smooth boundary.

B′2t—68 to 76 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak, medium, subangular blocky structure; slightly hard, very friable; coating on and bridging between sand grains; few pockets of sandy clay loam; noncalcareous; moderately alkaline; gradual, smooth boundary.

B′3—76 to 84 inches, yellowish-red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; weak, medium, subangular blocky structure; few pockets of clean sand grains; calcareous; moderately alkaline.

The solum ranges from 60 inches to more than 80 inches in thickness. The A1 horizon is 13 to 20 inches thick. It is reddish brown, light reddish brown, brown, and light brown and is mildly alkaline or neutral. The B2t, B3, A', B'2t, and B'3 horizons are reddish yellow to yellowish red. The B2t and B'2t horizons are fine sandy loam that has a clay content of 15 to 18 percent. The B3, A', and B'3 are loamy fine sand in most areas but range to sandy loam. In the Bt horizon sand grains are coated and bridged with clay loam. In the B3, A', and B'3 horizons clean sand grains are in most areas. In some areas films and threads of calcium carbonate are in the lower horizons at a depth of more than 40 inches.

**Springer loamy fine sand, 3 to 8 percent slopes** (SpD).—This gently sloping to sloping soil is on hummocky uplands. Areas are elongated or irregular in shape and are 20 to 150 acres in size.

Included with this soil in mapping are areas of Amarillo and Berda soils. Also included are some severely eroded areas of soils that were once cultivated. These areas have excavations, or blowouts, 1 foot to 4 feet deep that were caused by wind action. Some areas of soils that are calcareous within a depth of 40 inches from the surface and some areas of soils that have no Bt horizon below a depth of 60 inches are also included.

This Springer soil is used mostly as range. A few areas are cultivated. The main concerns in management are controlling erosion and conserving moisture. The hazards of soil blowing and erosion are severe.

Reseeding cultivated areas to native grass and providing for planned periods of deferred grazing to allow a vigorous growth of grass help to control soil blowing and erosion. Controlling brush by chemical or mechanical methods helps to conserve moisture. A brush-control program should allow for planned areas of wildlife habitat. Capability unit VIe–1, dryland; Sandy range site.

## Tulia Series

The Tulia series consists of deep, sloping to strongly sloping, loamy soils on uplands. These soils formed in loamy, calcareous material mostly of eolian origin.

In a representative profile the surface layer is brown, calcareous loam about 9 inches thick. The next layer is about 19 inches of light-brown clay loam that is about 50 percent calcium carbonate. Below this is reddish-yellow clay loam that extends to a depth of 64 inches. It is about 50 percent calcium carbonate in the upper part and about 35 percent calcium carbonate in the lower part.

Tulia soils are well drained. Runoff is slow to rapid, and permeability is moderate. Available water capacity is medium.

These soils are used as range.

In Floyd County, Tulia soils are mapped only with Posey soils.

Representative profile of Tulia loam in an area of Posey and Tulia soils, 5 to 12 percent slopes, 7.2 miles south on U.S. Highway 62 from its intersection with U.S. Highway 62 and 70 in Floydada and 400 feet west of the highway, in range:

A1—0 to 9 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; moderate, medium, granular structure and weak, medium, subangular blocky structure; slightly hard, friable; many roots; many worm casts in lower part; few small concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B21ca—9 to 28 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak, fine, subangular blocky structure and weak, fine, granular structure; hard, friable; many fine roots; few worm casts; about 50 percent, by volume, coarse soft masses and weakly cemented concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

B22tca—28 to 48 inches, reddish-yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak, medium, subangular blocky structure; hard, friable; few fine roots; few patchy clay films; few worm casts in upper part; many coarse soft masses and few weakly cemented concretions of calcium carbonate; about 50 percent, by volume, calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

B23tca—48 to 64 inches, reddish-yellow (5YR 7/6) clay loam, reddish yellow (5YR 6/6) moist; moderate, medium, subangular blocky structure; hard, friable; few fine pores; patchy clay films on faces of peds; many films, threads, and soft masses and few small concretions of calcium carbonate; estimated 35 percent, by volume, calcium carbonate; calcareous; moderately alkaline.

The A1 horizon is 4 to 11 inches thick and is reddish brown, brown, or dark brown. It is mainly loam, but it ranges to clay loam. The Bca horizon is more than 40 percent calcium carbonate in the control section and ranges up to 60 percent in some profiles. The Bca and Btca horizons are pink, reddish-yellow, and light-brown sandy clay loam to clay loam. The thickness of the Bt horizon ranges from 60 inches to more than 80 inches. The lower part of the Bt horizon is reddish yellow, red, and yellowish red.

## *Use and Management of the Soils*

This section describes general management for crops, explains the capability classification used by the Soil Conservation Service, gives predicted yields for the major crops on dryland and irrigated soils, and discusses range management and management of the soils for windbreaks. Management for individual mapping units is included in the section "Descriptions of the Soils." This section also provides interpretations of the soils for wildlife habitat and recreational development and tells about the use of the soils in engineering.

### Crops

The main crops grown in Floyd County are cotton, grain sorghum, and wheat. In the following paragraphs, general management for dryland and irrigated soils is described.

#### *General management for dryland soils*

The main concerns in management of dryland soils in Floyd County are controlling soil blowing, conserving moisture, and controlling erosion. The main factor that affects management is climate, which is characterized by high winds, severe droughts, high intensity rains, and hailstorms.

Dryland cultivated areas in Floyd County need a cropping system that incorporates the use of crops that produce a large amount of residue. The rotation of wheat or grain sorghum with cotton is adequate on most soils. In steeper areas, the continuous use of close-drilled small grains or feed crops is adequate to protect the soils.

*Controlling soil blowing.*—The hazard of soil blowing on some of the soils in Floyd County is moderate to severe. The soils that are most susceptible are the soils that have a surface layer of sand and sandy loam and soils that have a large amount of lime in the surface layer. Soils such as Amarillo, Drake, Estacado, Likes, Mansker, and Springer are more susceptible to soil blowing than are most other soils in the county.

One of the best methods of controlling soil blowing is managing crop residue on the soil surface (fig. 18). A crop can be harvested and the stalk or stubble left standing through the critical soil blowing periods of fall, winter, and spring. After a critical period is over, the residue can be incorporated into the soil.

Another method is leaving the stubble or crop residue on the surface and planting the next crop in the stubble. This method helps to prevent the young plants from being damaged by high winds and blowing soil particles. Using mulch or applying organic waste material to the soil surface also helps in controlling soil blowing. In this county, cotton burs and gin trash are widely used. Using about 3 tons of mulch per acre

*Figure 18.*—Grain sorghum residue on Pullman clay loam. Leaving crop residue on the surface is an effective way to control soil blowing and to increase water intake.

adequately protects most soils from soil blowing (fig. 19).

Growing a cover crop and stripcropping are also useful methods of controlling soil blowing. Keeping a cover of plants reduces the wind velocity on the soil surface and prevents soil blowing.

At times there may not be enough residue on the surface to control soil blowing. An effective emergency method is roughening the soil surface to make it cloddy. This practice is used mostly after rains have made the soil surface highly susceptible to blowing. A harrow, chisels, or rotary hoe are useful for the emergency tillage.

*Conserving moisture.*—Maintaining crop residue on the soil surface also helps to conserve moisture. Leaving residue on the surface reduces evaporation and increases water intake. Planting soil-improving crops and legumes, farming on the contour, and using terraces and land leveling help to keep moisture at a higher level. Soil-improving crops and legumes tend to keep a soil open and friable, which allows water to infiltrate readily. Tilling the soil while it is wet tends to pack the soil and reduces infiltration of water. Farming on the contour, terracing, and land leveling help water move into the soil.

*Controlling erosion.*—Contour farming, terracing, and using diversion terraces help to control erosion. These practices allow excess runoff to move from an area at a safe rate. Grassed waterways also help in carrying excess runoff at a safe rate. Terraces, diversion terraces, and natural drainageways can empty in the grassed waterways and dispose of excess runoff. To be effective, grass in the waterways should be protected from fire and excessive grazing.

Maintaining crop residue on the soil surface also helps to reduce erosion. By increasing water infiltration into the soil, runoff is reduced, and erosion is thereby reduced.

### *General management for irrigated soils*

Most of the cultivated areas in Floyd County are irrigated where water is available. Surface irrigation systems are the most widely used. A few soils that have a surface layer and subsoil of sand or those soils that are gently sloping require a sprinkler irrigation system. Lofton, Olton, and Pullman soils are nearly level and are well suited to graded furrow irrigation (fig. 20). Amarillo, Estacado, Mansker, and Mobeetie soils are well suited to sprinkler irrigation.

Controlling soil blowing and erosion and conserving moisture require many of the same practices as those discussed in the management of dryland cultivated areas. The same principles used in cropping systems for dryland cultivated areas should be used in irrigated areas.

Irrigated areas need a properly designed irrigation system to conserve soil moisture and prevent erosion. Water must be applied in amounts determined by the kind of soil and the needs of the crop. In graded furrow irrigation systems, the row length should be

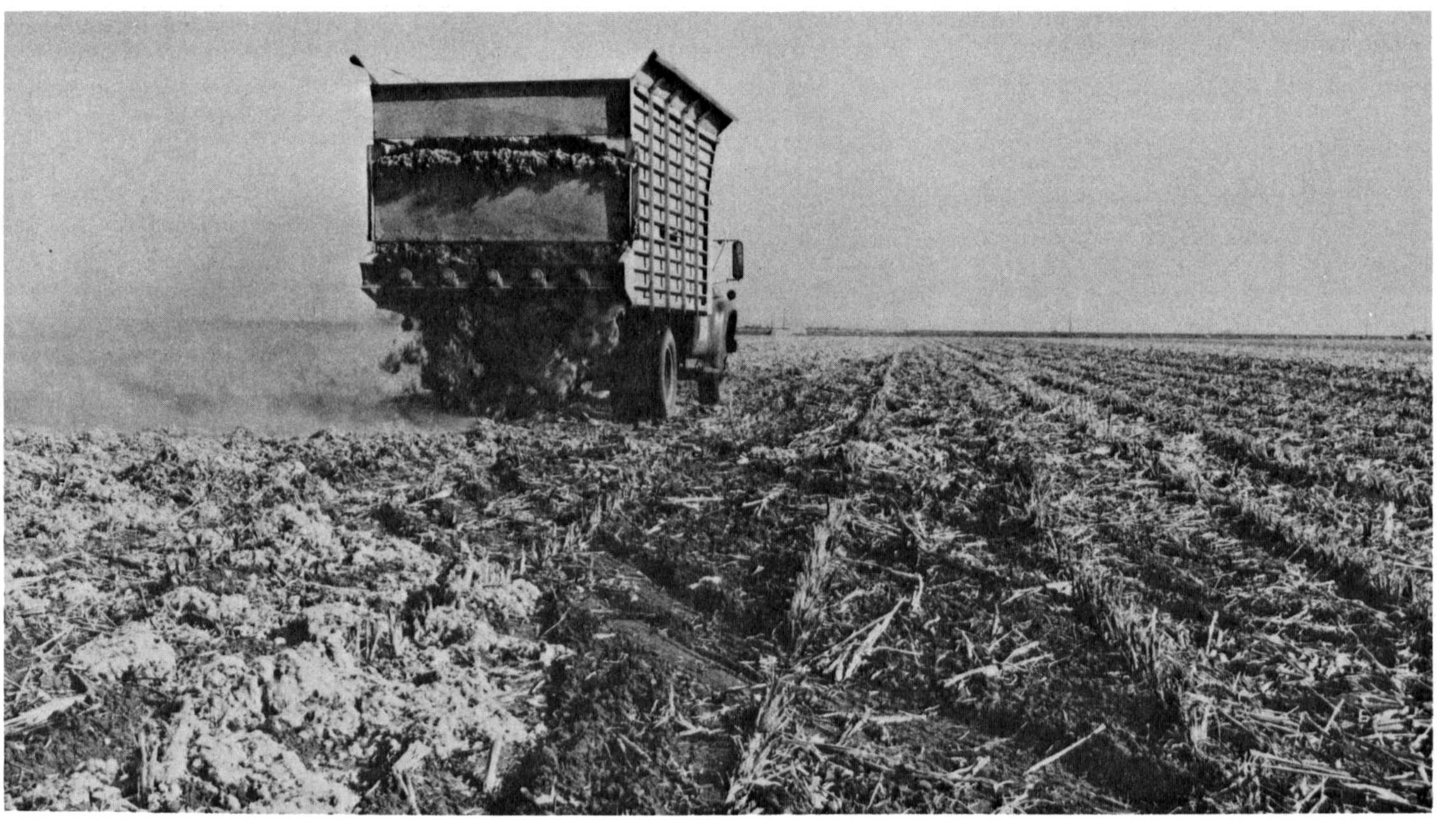

***Figure 19.*—Mulching with cotton burs to control soil blowing on Estacado clay loam.**

*Figure 20.*—**Furrow irrigation of grain sorghum on Pullman clay loam. Using gated pipe for irrigation conserves water.**

designed to prevent loss of irrigation water through deep percolation and to insure adequate irrigation.

A soil-improving and fertility program is needed more on irrigated soils than on dryland soils, because the crops are higher yielding and quickly deplete the soil of plant nutrients. The best way to maintain fertility and productivity is to return a large amount of residue to the soil. Nitrogen fertilizer added to the crop residue helps to decompose it and aids in preventing a nitrogen shortage in the following crop.

The acreage of irrigated pasture has been increasing in the past few years. The main kinds of grasses are Midland bermudagrass, side-oats grama, switchgrass, indiangrass, and other tall grasses. Proper management of pasture includes fertility maintenance, water management, and rotation grazing (fig. 21).

### *Capability grouping*

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soil on their farm. These readers can make good use of the capability classification system, a grouping that shows, in a general way, the suitability of soils for most kinds of farming.

The grouping is based on permanent limitations of soils when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range or for engineering.

In the capability system, all kinds of soil are grouped at three levels: the class, the subclass, and the unit. The broadest grouping, the capability class, is designated by Roman numerals I to VIII. In class I are the soils that have the fewest limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progres-

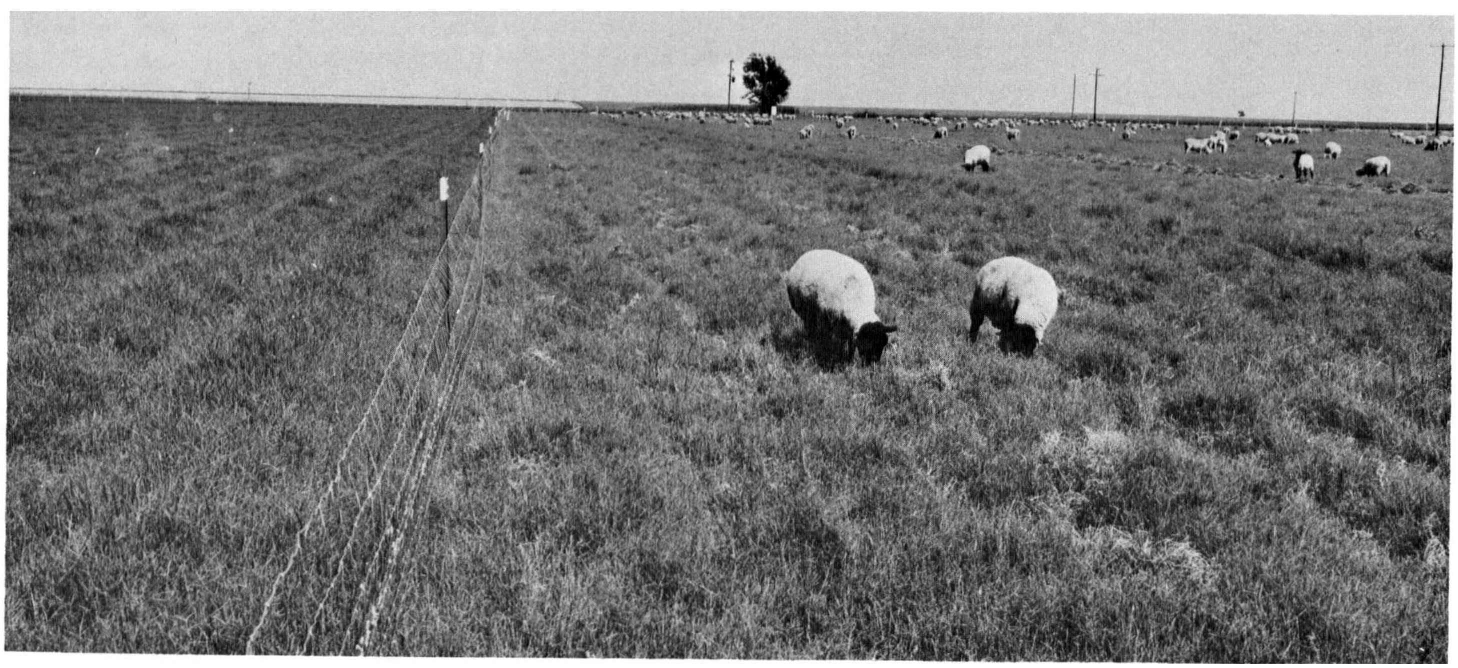

*Figure 21.*—**Irrigated pasture of Midland bermudagrass on Pullman clay loam. Pasture is fenced for rotation grazing.**

sively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclass indicates major kinds of limitations within the classes. Within most of the classes there can be as many as four subclasses. The subclasses are indicated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in some parts of the United States but not in Floyd County, indicates that the chief limitation is climate that is too cold or too dry.

Class I has no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only the subclasses indicated by *w, s,* and *c,* because the soils in it are subject to little or no erosion. These soils have other limitations, however, that restrict their use largely to pasture, range, wildlife habitat, or recreational purposes.

Subclasses are further divided into groups called capability units. These are groups of soils that are enough alike that they are suited to the same crops and pasture plants, they require about the same management, and they have generally similar productivity and other response to management. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIe-4.

The eight classes in the capability system and the subclasses and the units in Floyd County are described in the list that follows. The unit designation for each soil is given in the "Guide to Mapping Units."

###### DRYLAND CAPABILITY UNITS

Class I. Soils have few limitations that restrict their use. (None in Floyd County)

Class II. Soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

- Subclass IIe. Soils are subject to moderate erosion if they are not protected.
  - Unit IIe-1. Deep, nearly level clay loams that are well drained and moderately permeable.

Class III. Soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.

- Subclass IIIe. Soils are subject to severe erosion if they are cultivated and not protected.
  - Unit IIIe-1. Deep, gently sloping clay loams that are well drained and very slowly permeable.
  - Unit IIIe-2. Deep, gently sloping loams to clay loams that are well drained and moderately permeable to moderately slowly permeable.
  - Unit IIIe-3. Deep, nearly level to gently sloping fine sandy loams to loams that are well drained and moderately permeable.
  - Unit IIIe-4. Deep, nearly level clay loams that are well drained to moderately well drained and very slowly permeable.
  - Unit IIIe-5. Deep, nearly level loams to clay loams that are well drained and moderately permeable to moderately slowly permeable.

Class IV. Soils have very severe limitations that reduce the choice of plants or require very careful management, or both.

- Subclass IVe. Soils are subject to very severe erosion if they are cultivated and not protected.
  - Unit IVe-1. Deep, gently sloping fine sandy loams to clay loams that are well drained and moderately permeable.
  - Unit IVe-2. Deep, gently sloping fine sandy loams that are well drained and moderately permeable.
  - Unit IVe-3. Deep, gently sloping fine sandy loams to clay loams that are well drained and moderately permeable.
  - Unit IVe-4. Deep, nearly level to gently sloping fine sandy loams that are well drained and moderately rapidly permeable.
  - Unit IVe-5. Deep, gently sloping loams that are well drained and moderately permeable.
- Subclass IVs. Soils are very severely limited because of tilth.
  - Unit IVs-1. Deep, nearly level clays that are somewhat poorly drained and very slowly permeable.

Class V. Soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife habitat.

- Subclass Vw. Soils are too wet for cultivation; drainage or protection is not feasible.
  - Unit Vw-1. Deep, nearly level clay loams that are well drained and moderately permeable.
  - Unit Vw-2. Deep, nearly level fine sandy loams that are somewhat excessively drained and rapidly permeable.

Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

- Subclass VIe. Soils are severely limited, mainly by risk of erosion if protective cover is not maintained.
  - Unit VIe-1. Deep, gently sloping to sloping loamy fine sands that are well drained to excessively drained and moderately rapidly permeable.
  - Unit VIe-2. Deep, sloping to moderately steep fine sandy loams to loams that are well drained and moderately permeable.
  - Unit VIe-3. Deep to shallow, gently sloping to strongly sloping soils that are well drained and moderately permeable to moderately rapidly permeable.

Subclass VIs. Soils are severely limited because of gravel.

Unit VIs–1. Deep, gently sloping to steep loams to gravelly sandy loams that are well drained to excessively drained and moderately permeable to moderately rapidly permeable.

Subclass VIw. Soils are severely limited because they are flooded; drainage or protection is not feasible.

Unit VIw–1. Deep, nearly level clays that are somewhat poorly drained and very slowly permeable.

Class VII. Soils have very severe limitations that make them unsuited to cultivation and restrict their use largely to range, woodland, or wildlife habitat.

Subclass VIIe. Soils are very severely limited, mainly by risk of erosion if protective cover is not maintained.

Unit VIIe–1. Deep to very shallow, steep loams that are well drained and moderately permeable.

Subclass VIIs. Soils are very severely limited because of soil depth or stoniness.

Unit VIIs–1. Very shallow to shallow, sloping to moderately steep fine sandy loams that are well drained and moderately permeable.

Class VIII. Soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes. (None in Floyd County)

IRRIGATED CAPABILITY UNITS

Class I. Soils have few limitations that restrict their use. (None in Floyd County)

Class II. Soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Subclass IIe. Soils are subject to moderate erosion if they are not protected.

Unit IIe–1. Deep, nearly level clay loams that are well drained and moderately permeable to moderately slowly permeable.

Unit IIe–2. Deep, nearly level fine sandy loams to loams that are well drained and moderately permeable.

Subclass IIs. Soils have moderate limitations because permeability is very slow.

Unit IIs–1. Deep, nearly level clay loams that are well drained to moderately well drained and very slowly permeable.

Class III. Soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.

Subclass IIIe. Soils are subject to severe erosion if they are cultivated and not protected.

Unit IIIe–1. Deep, gently sloping clay loams that are well drained and very slowly permeable.

Unit IIIe–2. Deep, gently sloping loams to clay loams that are well drained and moderately permeable to moderately slowly permeable.

Unit IIIe–3. Deep, nearly level to gently sloping fine sandy loams that are well drained and moderately permeable to moderately rapidly permeable.

Unit IIIe–4. Deep, gently sloping fine sandy loams to clay loams that are well drained and moderately permeable.

Unit IIIe–5. Deep, gently sloping loams that are well drained and moderately permeable.

Class IV. Soils have very severe limitations that reduce the choice of plants or require very careful management, or both.

Subclass IVe. Soils are subject to very severe erosion if they are cultivated and not protected.

Unit IVe–1. Deep, gently sloping fine sandy loams that are well drained and moderately permeable.

Unit IVe–2. Deep, gently sloping fine sandy loams and loams to clay loams that are well drained and moderately permeable.

Subclass IVs. Soils are very severely limited because of tilth.

Unit IVs–1. Deep, nearly level clays that are somewhat poorly drained and very slowly permeable.

### *Predicted yields*

The predicted yields of the principal crops grown in Floyd County are given in table 2. The predictions are based on estimates made by farmers, soil scientists, and others who have knowledge of yields in the county and on information taken from research data. The predicted yields are average yields per acre that can be expected by good commercial farmers at the level of management which tends to produce the highest economic returns.

The yields are given for both dryland and irrigated soils if the soils are used for both methods of farming. If only one method is practical, yields for only this method of farming are given. Not included in this table are soils that are used only as range or for recreational purposes.

Crops other than those shown in table 2 are grown in the county, but they are not listed because their acreage is small or reliable data on yields are not available.

The predicted yields given in table 2 can be expected if the following management practices are used—

For dryland:

1. Rainfall is effectively used and conserved.
2. Surface and subsurface drainage systems, or both, are installed.
3. Crop residue is managed to maintain soil tilth.
4. Tillage is minimal but timely.
5. Insect, disease, and weed control measures are consistently used.
6. Fertilizer is applied according to soil test and crop needs.

TABLE 2.—*Predicted average yields per acre for principal crops under high-level management*

[Dashes in a column indicate that the soil is not suitable or the crop is not commonly grown on the soil]

| Soil | Cotton (lint) | | Grain sorghum | | Wheat | |
|---|---|---|---|---|---|---|
| | Dryland | Irrigated | Dryland | Irrigated | Dryland | Irrigated |
| | *Lb* | *Lb* | *Lb* | *Lb* | *Bu* | *Bu* |
| Amarillo fine sandy loam, 0 to 1 percent slopes | 200 | 900 | 1,350 | 6,500 | 15 | 60 |
| Amarillo fine sandy loam, 1 to 3 percent slopes | 195 | 850 | 1,100 | 5,500 | 15 | 50 |
| Amarillo fine sandy loam, 3 to 5 percent slopes | 150 | 550 | 800 | 4,000 | 10 | 35 |
| Berda loam, 1 to 3 percent slopes | 175 | 675 | 1,250 | 4,500 | 15 | 45 |
| Berda loam, 3 to 5 percent slopes | ---------- | ---------- | 900 | 3,500 | 10 | 35 |
| Bippus clay loam, 0 to 1 percent slopes | 250 | 850 | 1,750 | 7,500 | 20 | 60 |
| Drake soils, 1 to 3 percent slopes | 100 | 600 | 600 | 3,500 | 10 | 40 |
| Drake soils, 3 to 5 percent slopes | ---------- | ---------- | ---------- | 3,000 | ---------- | 30 |
| Estacado clay loam, 0 to 1 percent slopes | 200 | 800 | 1,250 | 5,500 | 15 | 55 |
| Estacado clay loam, 1 to 3 percent slopes | 150 | 750 | 1,250 | 5,000 | 15 | 45 |
| Flomot fine sandy loam, 1 to 3 percent slopes | 150 | 500 | 900 | 3,500 | 15 | 30 |
| Flomot fine sandy loam, 3 to 5 percent slopes | 125 | ---------- | 750 | 3,000 | 10 | 25 |
| Lofton clay loam | 190 | 850 | 1,200 | 7,000 | 15 | 60 |
| Mansker clay loam, 1 to 3 percent slopes | 150 | 600 | 900 | 4,000 | 15 | 35 |
| Mansker clay loam, 3 to 5 percent slopes | ---------- | ---------- | 750 | 3,500 | 10 | 30 |
| Mobeetie fine sandy loam, 0 to 3 percent slopes | 200 | 800 | 1,250 | 5,000 | 15 | 45 |
| Olton clay loam, 0 to 1 percent slopes | 200 | 900 | 1,200 | 6,500 | 15 | 60 |
| Olton clay loam, 1 to 3 percent slopes | 175 | 825 | 1,000 | 6,000 | 15 | 50 |
| Paloduro loam, 0 to 1 percent slopes | 200 | 800 | 1,350 | 6,500 | 15 | 55 |
| Portales loam, 0 to 1 percent slopes | 200 | 800 | 1,250 | 6,000 | 15 | 50 |
| Pullman clay loam, 0 to 1 percent slopes | 175 | 850 | 1,250 | 7,000 | 15 | 55 |
| Pullman clay loam, 1 to 3 percent slopes | 150 | 800 | 1,000 | 6,000 | 10 | 45 |
| Randall clay (drained) | ---------- | 400 | 1,000 | 3,500 | 10 | 25 |

7. Suited crop varieties are used at recommended seeding rates.

For irrigated areas the following additional practices are used:

8. A suitable quality of irrigation water is used.
9. Irrigation is timed to meet the need of the soil and crop.
10. Irrigation systems are properly designed and efficiently used.

## Range [2]

Ranching and livestock farming are important agricultural enterprises in Floyd County. About 25 percent of the county is in native range. Each year, this acreage increases because cultivated areas are being reestablished to permanent grass. This trend is encouraged by a constant drop in the water table from which irrigation water is pumped. Most of the soils that are being planted to grass are shallow and are poor crop producers under dryland conditions.

Most of the ranches are used as cow-calf operations. Many thousands of acres of cultivated areas are sown each year to wheat that is used for grazing steers and a few herds of sheep. When extra feed is available, ranchers frequently supplement their cowherds with herds of steers purchased in the fall.

Floyd County cattlemen have been influential early pioneers in establishing cattle feedlots. Recently, there has been an increase in interest for hog feedlots. Irrigated grain sorghum fields that produce high yields per acre have contributed to the increase in the number of cattle fed out each year.

In recent years, returns from native range have increased from hunting leases. Most of the ranching area is located in the northeastern and eastern parts of the county. Hunting leases for deer, quail, and turkey are becoming more popular in these areas. White-tailed deer are plentiful. Mule deer and aoudad have been introduced in the area adjacent to the Caprock. These animals are increasing in number and soon will be a part of the hunter's harvest.

Three broad kinds of grassland are in Floyd County. Clayey hardland sites are scattered throughout the county, except in the eastern and northeastern parts. Shallow and very shallow sites are along and adjacent to the Caprock Escarpment, which is in a northwest to southeast direction in the northeastern fourth of the county. Sand and sandy loam sites are in areas below the Caprock. Smaller areas of gravelly, high lime sites and bottom land sites are interspersed throughout the county.

### *Range sites and condition classes*

Soils differ in their capacity to produce grass and other plants for grazing. Soils that produce about the same kinds and amounts of forage, if the range is in similar condition, make up a range site.

Range sites are kinds of rangeland that differ in their ability to produce vegetation. The soils of any one range site produce about the same kind and amount of climax vegetation. Climax vegetation is the stabilized plant community; it reproduces itself and does

[2] By JOE B. NORRIS, range conservationist, Soil Conservation Service.

not change so long as the environment remains unchanged. The climax vegetation consists of the plants that were growing on a given soil when the region was first settled. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

Decreasers are plants in the climax vegetation that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and the most palatable to livestock.

Increasers are plants in the climax vegetation that increase in relative amount as the more desirable decreaser plants are reduced by close grazing. They are commonly shorter than decreasers and are generally less palatable to livestock.

Invaders are plants that cannot compete with plants in the climax plant community for moisture, nutrients, and light. Hence, invaders come in and grow along with increasers after the climax vegetation has been reduced by grazing. Many are annual weeds, and some are shrubs that have some grazing value, but others have little value for grazing.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. Range condition class indicates the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.

A range is in *excellent* condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand. It is in *good* condition if the percentage is 51 to 75; in *fair* condition if the percentage is 26 to 50; and in *poor* condition if the percentage is less than 25.

Range condition is judged according to standards that apply to the particular range site. It expresses the present kind and amount of vegetation in relation to the climax plant community for that site.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during their growing season.

A primary objective of good range management is to keep the range in excellent or good condition. If this is done, water is conserved, yields are improved or maintained, and the soils are protected. The major concern in range management is recognizing important changes in the kind of cover on a range site. These changes take place gradually and can be misinterpreted or overlooked. Plant growth encouraged by heavy rainfall may lead to the conclusion that the range is in good condition, when actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some range that has been closely grazed for short periods, under the supervision of a careful manager, may have a degraded appearance that temporarily conceals its quality and its capacity to recover.

### *Descriptions of the range sites*

In the following paragraphs, the range sites of Floyd County are described, and the climax plants and principal invaders on the sites are named. Also given is an estimate of the potential average annual acre yield of air-dry herbage in both wet and dry years for each site where it is in excellent condition. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this survey.

#### CLAY LOAM RANGE SITE

This range site is made up mainly of deep, nearly level to gently sloping, loamy soils on smooth, upland plains. It is readily accessible to livestock and is a favorite area for grazing. Permeability is moderately slow to very slow, and available water capacity is high. The hazard of soil blowing is slight, and the hazard of erosion is slight to moderate.

The climax plants are short and mid grasses. The approximate kinds of plants in percentage by weight are blue grama, 35; buffalograss, 25; vine-mesquite, 10; perennial three-awns, 5; tobosagrass, 5; side-oats grama, 5; feathery bluestems, 5; sand dropseed, 5; and forbs, 5.

Continuous overgrazing results in an immediate decrease in blue grama and an increase in buffalograss. Further site deterioration results in invasion by perennial three-awns, Texas grama, hairy tridens, pricklypear, and mesquite. When this site is in fair or poor condition and during years that have a wet spring, invading annuals are on bare spots. The most common annual plants are Texas filaree, evax, plantains, bladderpods, bitterweed, common broomweed, and little barley. Invading perennial forbs are commonly western ragweed and silverleaf nightshade.

This site is capable of only limited production. A protective plant cover is needed to reduce surface crusting and to prevent erosion. Where the site is in poor condition, blue grama recovers slowly because it lacks vigor. Where the site is in excellent condition, the average annual yield of air-dry herbage ranges from 2,300 pounds per acre in wet years to 1,300 pounds per acre in dry years. Approximately 85 percent of this herbage can be used by livestock and wildlife.

#### GRAVELLY RANGE SITE

Polar and Paloduro soils, 3 to 30 percent slopes, are the only soils in this site. These deep, gently sloping to steep, gravelly loamy to loamy soils are on hills and knolls. Permeability is moderate to moderately rapid, and available water capacity is low to high. The hazards of soil blowing and erosion are slight to moderate.

The approximate kinds of climax plants in percentage by weight are side-oats grama, 30; little bluestem, 20; black grama, 10; sand bluestem, 5; blue grama, 5; hairy grama, 5; other grasses, 15; and forbs and woody plants, 10.

If the site is continuously heavily grazed, Texas grama, sand muhly, hairy tridens, pricklypear, cactus, and annuals invade. As the site deteriorates and the topsoil is eroded, the ability of the site to produce forage is greatly reduced. In many areas there is little more than a gravel bed in which to grow grass.

This site responds favorably to good range management. Seldom are all of the desirable kinds of plants

grazed out. The site is an excellent source of forage for deer. The amount of herbage produced on this site is influenced by the annual rainfall as well as by the degree of past erosion. Where the site is in excellent condition, the average annual yield of air-dry herbage ranges from 1,800 pounds per acre in wet years to 1,200 pounds per acre in dry years. Approximately 60 percent of this herbage can be used by livestock and wildlife.

#### HARDLAND SLOPES RANGE SITE

This range site is made up of deep, nearly level to moderately steep soils mostly along draws and drainageways. Permeability is moderate, and available water capacity is medium to high. The hazard of soil blowing is slight to moderate, and the hazard of erosion is slight to severe.

The approximate kinds of climax plants in percentage by weight are side-oats grama, 30; blue grama, 20; buffalograss, 10; feathery bluestems, 10; little bluestem, 5; plains bristlegrass, 5; buffalograss, 5; sand dropseed, 5; and forbs, 10.

If the site is heavily grazed, side-oats grama decreases and blue grama increases. Further deterioration results in an invasion by three-awns, mesquite, sand muhly, broom snakeweed, and pricklypear.

This site is capable of moderate production. Where the site is in excellent condition, the average annual yield of air-dry herbage ranges from 2,500 pounds per acre in wet years to 1,200 pounds per acre in dry years. Approximately 75 percent of this herbage can be used by livestock and wildlife. Once the site is in poor condition, recovery of the desirable kinds of plants is slow.

#### HIGH LIME RANGE SITE

This range site is made up of deep, gently sloping, loamy soils on uplands. Most areas are on the eastern side of playa lakes. Permeability is moderate, and available water capacity is medium. The hazard of soil blowing is severe, and the hazard of erosion is moderate.

The approximate kinds of climax plants in percentage by weight are blue grama, 25; alkali sacaton, 20; buffalograss, 10; vine-mesquite, 5; perennial three-awns, 5; silver bluestem, 5; plains bristlegrass, 5; and other plants, 25.

In areas where the percentage of lime or salt increases, alkali sacaton increases and inland saltgrass invades. Deterioration of this site results in an invasion by Russian thistle, pickleweed, whorled dropseed, and inland saltgrass.

Where this site is in excellent condition, the average annual yield of air-dry herbage ranges from 1,800 pounds per acre in wet years to 1,100 pounds per acre in dry years. Approximately 80 percent of this herbage can be used by livestock and wildlife.

#### MIXEDLAND RANGE SITE

Obaro and Quinlan soils, 5 to 12 percent slopes, are the only soils in this site. The shallow to deep, sloping to strongly sloping, loamy soils are in areas that have defined drainage patterns. Permeability is moderate to moderately rapid, and available water capacity is low to medium. The hazard of soil blowing is moderate, and the hazard of erosion is severe.

The climax plants are dominantly mid grasses and lesser amounts of short grasses. The approximate kinds of plants in percentage by weight are blue grama, 25; side-oats grama, 10; buffalograss, 20; Arizona cottontop, 5; plains bristlegrass, 5; western wheatgrass, 5; hairy grama, 5; sand dropseed, 5; feathery bluestems, 5; other grasses such as little bluestem, fall witchgrass, and perennial three-awns, about 10 percent; and woody plants and forbs, about 5 percent.

Any deterioration in this site results in an immediate decrease in blue grama, Arizona cottontop, and plains bristlegrass. Side-oats grama is the next prominent grass to decrease. If the site is overgrazed, the range vegetation soon consists of buffalograss and numerous invading forbs. Plains bristlegrass and Arizona cottontop grow only in protected areas. The main invading grasses are red grama, Texas grama, sixweeks grama, tumbleweed windmillgrass, hood windmillgrass, gummy lovegrass, little barley, tumblegrass, and hairy tridens. Woody invaders are mesquite, pricklypear, tasajillo, and small soapweed. Vegetation on the shallower soils is mostly less dense than on other soils in the site; however, side-oats grama is somewhat more abundant.

If the site is in poor condition, recovery is slow because viable seeds from climax plants are lacking and because the soils have a surface crust. This site responds to reseeding. Where it is in excellent condition, the average annual yield of air-dry herbage ranges from 2,400 pounds per acre in wet years to 1,200 pounds per acre in dry years. Approximately 75 percent of this herbage can be used by livestock and wildlife.

#### MIXEDLAND SLOPES RANGE SITE

This range site is made up of deep, nearly level to strongly sloping, loamy soils in areas just below the Caprock Escarpment. Permeability is moderate to moderately rapid, and available water capacity is medium. The hazards of soil blowing and erosion are moderate to severe.

The climax plants are mid and tall grasses and an abundance of forbs. The approximate kinds of plants in percentage by weight are side-oats grama, 30; blue grama, 15; little bluestem, 5; sand bluestem, 5; plains bristlegrass, 5; feathery bluestems, 5; perennial three-awns, 5; buffalograss, 5; other grasses and forbs, 20; and woody plants, 5.

If the site is continuously heavily grazed, side-oats grama decreases, and blue grama and buffalograss increase. If overgrazing is prolonged, sand dropseed, three-awns, and fall witchgrass increase and yucca, catclaw acacia, and mesquite invade.

This site responds favorably to good range management. In most places sufficient quantities of desirable plants remain on the site even where it is in poor condition. Where this site is in excellent condition, the average annual yield of air-dry herbage ranges from 2,200 pounds per acre in wet years to 1,500 pounds per acre in dry years. Approximately 30 percent of this herbage can be used by livestock and wildlife.

#### ROUGH BREAKS RANGE SITE

Berda and Potter soils, steep, are the only soils in this site. These very shallow to deep, steep, loamy soils are mostly within and along the Caprock Escarpment. Permeability is moderate, and available water capacity is medium to high. The hazard of soil blowing is moderate, and the hazard of erosion is severe.

The approximate kinds of climax plants in percentage by weight are side-oats grama, 20; little bluestem, 20; blue grama, 5; sand bluestem, 5; indiangrass, 5; plains bristlegrass, 5; slim tridens and rough tridens, 5; hairy grama, 5; black grama, 5; and feathery bluestems, 5. Redberry juniper, feather dalea, skunkbush, and catclaw acacia grow on slopes. These plants and other grasses and forbs make up about 20 percent of the total yield.

Even where the site is in excellent condition, density of plant cover is sparse. If the site is continuously heavily grazed, Texas grama, hairy tridens, sand muhly, and annuals invade. If overgrazing is prolonged, the steep slopes lose their protective plant cover; erosion is accelerated; and soil loss is severe. Intense management and protection must be applied before stabilization is accomplished. The total potential yield of this site is negligible when compared to surrounding sites. Consequently, grazing a pasture in such a manner as to deteriorate this site will result in deterioration of the entire pasture.

Where this site is in excellent condition, the average annual yield of air-dry herbage ranges from 900 pounds per acre in wet years to 300 pounds per acre in dry years. Approximately 50 percent or less of this herbage can be used by livestock because of inaccessibility. Wildlife is better able to use the vegetation on steeper slopes.

#### SANDY RANGE SITE

This range site is made up of deep, gently sloping to sloping, sandy soils on uplands. Permeability is moderately rapid, and available water capacity is low to very low. The hazards of soil blowing and erosion are severe.

The climax plants are a mixture of tall and mid grasses. Both forbs and browse are available in significant quantities. The approximate kinds of plants in percentage by weight are sand bluestem, 25; indiangrass, 20; little bluestem, 15; feathery bluestems, 10; hooded windmillgrass, 5; fall witchgrass, 5; hairy grama, 5; and other grasses and forbs, 5. Motts of Havard oak or shin oak are scattered throughout the site and make up 10 percent of the total yield.

Any deterioration in this site results in a rapid increase in small soapweed (yucca), shin oak, and annual weeds and grasses. Such grasses and annual three-awn, fringed signalgrass, tumble windmillgrass, gummy lovegrass, red lovegrass, and tumble lovegrass invade. Such weeds as tumble ringwing, annual wild-buckwheat, prairie sunflower, woollywhite, beebalm, pricklypoppy, Riddell groundsel, and stillingia also invade.

Because shin oak so readily invades this site, this plant must frequently be controlled before grasses can make any recovery. Mechanical methods of control are not feasible, because there is a hazard of soil blowing if these methods are used. The site responds favorably to chemical control of shin oak. It has the ability to return to good to excellent condition in a few years if management is good and if a seed source is available. Where response is slow, overseeding by the best known methods speeds recovery.

This site is widely variable in production from year to year. This variation is influenced by the amount of rain received annually during the growing season. Where the site is in excellent condition, the average annual yield of air-dry herbage ranges from 3,200 pounds per acre in wet years to 1,500 pounds per acre in dry years. Approximately two-thirds of this herbage can be used by livestock and wildlife.

#### SANDY BOTTOMLAND RANGE SITE

Lincoln soils, frequently flooded, are the only soils in this site. These deep, loamy soils are on bottom lands along creeks in the county. The winding stream channel causes a difference in the width of the site on either side of the drainageways. Permeability is rapid, and available water capacity is low. The hazard of soil blowing is severe, and the hazard of erosion is slight.

The approximate kinds of climax plants in percentage by weight are sand bluestem, 15; indiangrass, 15; little bluestem, 10; switchgrass, 10; side-oats grama, 10; feathery bluestem, 5; vine-mesquite, 5; other grasses, 15; and such forbs as Illinois bundleflower, daleas, and prairie-clover, 5. Such woody plants as cottonwood, pecan, hackberry, bumelia, and skunkbush sumac make up 10 percent of the total yield.

This site is commonly deteriorated to a saline condition. When the salt content is sufficiently high to affect vegetative growth, all kinds of climax plants decrease and alkali sacaton invades. Salt-tolerant grasses such as switchgrass are the last kind of climax plant to decrease.

Where this site is in excellent condition, the average annual yield of air-dry herbage ranges from 3,000 pounds per acre in wet years to 2,200 pounds per acre in dry years. Approximately 70 percent of this herbage can be used by livestock and wildlife. If the salt content of the soils is high, production may be reduced as much as 50 percent.

#### SANDY LOAM RANGE SITE

This range site is made up of deep, nearly level to gently sloping, loamy soils on uplands. Permeability is moderate, and available water capacity is high. The hazards of soil blowing and erosion are moderate to severe.

The climax plants are mainly mid grasses, but there are limited amounts of tall grasses. The approximate kinds of plants in percentage by weight are blue grama, 25; side-oats grama, 10; Arizona cottontop, 10; plains bristlegrass, 10; buffalograss, 10; hairy grama, 5; hooded windmillgrass, 5; silver bluestem, 5; perennial three-awns, 5; sand dropseed, 5; and browse and forbs, 10.

If the site is continuously heavily grazed, sand dropseed, three-awns, mesquite, and annuals invade. Frequently, this site is treated for the invasion of

brush. Mechanical as well as chemical methods are effective, and grazing is deferred following these practices to permit grass recovery.

Where this site is in excellent condition, the average annual yield of air-dry herbage ranges from 2,400 pounds per acre in wet years to 1,500 pounds per acre in dry years. About two-thirds of this herbage can be used by livestock and wildlife.

#### VALLEY RANGE SITE

This range site is made up of deep, nearly level, loamy soils in low areas of major draws. Although flooded from time to time, it is under water for only a short period. Any damage to vegetation is ordinarily from sedimentation rather than from wetness. Permeability is moderate, and available water capacity is very high. The hazards of soil blowing and erosion are slight.

The climax plants are dominantly mid grasses and lesser amounts of short grasses. The approximate kinds of plants in percentage by weight are side-oats grama, 25; little bluestem, 15; vine-mesquite, 10; blue grama, 10; white tridens, 5; buffalograss, 5; western wheatgrass, 5; feathery bluestems, 5; other grasses, 10; and such browse as hackberry, catclaw acacia, and perennial forbs, 10. If the site is continuously heavily grazed, mesquite and annuals invade.

The site responds favorably to deferred grazing practices, particularly when management is applied before all the more desirable grasses are grazed out. Where the site is in excellent condition, the average annual yield of air-dry herbage ranges from 3,000 pounds per acre in wet years to 1,800 pounds per acre in dry years. About 90 percent of this herbage can be used by cattle and wildlife.

#### VERY SHALLOW RANGE SITE

This range site is made up of very shallow to shallow, gently sloping to moderately steep, loamy soils. Some areas have exposed rock. Permeability is moderate, and available water capacity is very low. The hazard of soil blowing is slight to moderate, and the hazard of erosion is severe.

The climax plants are mostly mid grasses. The approximate kinds of plants in percentage by weight are side-oats grama, 30; blue grama, 10; little bluestem, 10; hairy grama, 10; buffalograss, 10; sand dropseed, 5; perennial three-awns, 5; slim tridens or rough tridens, 5; and other grasses, forbs, and woody plants, 15.

If the site is continuously heavily grazed, hairy tridens, Texas grama, red grama, tumblegrass, mesquite, catclaw acacia, pricklypear, broom snakeweed, and annuals invade.

Where this site is in excellent condition, the average annual yield of air-dry herbage ranges from 1,000 pounds per acre in wet years to 400 pounds per acre in dry years. Approximately 60 percent of this herbage can be used by livestock.

## Wildlife [3]

In Floyd County, the main kinds of wildlife are white-tailed deer, mule deer, aoudad, turkey, bobwhite quail, scaled (blue) quail, dove, cottontail rabbit, jackrabbit, and numerous kinds of nongame birds. Raccoon, fox, skunk, opossum, and other furbearers live in the county. Predators commonly found in the county are bobcat and coyote. Playa lakes, streams, ponds, and grainfields attract ducks and geese during migration. Most farm and ranch ponds are stocked with channel catfish, black bass, and sunfish. Fish and wildlife resources are of minor economic importance to landowners in this county. A few landowners lease their land for hunting of aoudad, deer, turkey, and quail.

Soils directly influence the kind and amount of vegetation and the amount of water available. In this way they indirectly influence the kinds of wildlife that can live in an area. Soil properties that affect the growth of wildlife habitat are (1) thickness of soil useful to crops, (2) texture of the surface layer, (3) available water capacity to a depth of 40 inches, (4) wetness, (5) surface stoniness or rockiness, (6) flood hazard, (7) slope, and (8) permeability of the soil to air and water.

In table 3, the soils of Floyd County are rated according to their suitability for producing six elements of wildlife habitat and for three groups, or kinds, of wildlife. The ratings indicate relative suitability for various elements.

A rating of *good* indicates that habitat is generally easily created, improved, or maintained. The soil has few or no limitations that affect management, and satisfactory results can be expected when the soil is used for the prescribed purpose.

A rating of *fair* indicates that habitat can be created, improved, or maintained in most places, but the soil has moderate limitations that affect management or development. A moderate intensity of management and fairly frequent attention may be required to insure satisfactory results.

A rating of *poor* indicates that habitat can be created, improved, or maintained in most places, but the soil has severe limitations. Management is difficult, expensive, and requires intensive effort. Results are questionable.

A rating of *very poor* indicates that under the prevailing soil conditions, it is impractical to attempt to create, improve, or maintain habitat. Soil conditions are very severe, and unsatisfactory results are probable.

Each soil is rated in table 3 according to its suitability for producing various kinds of plants and other elements that make up wildlife habitats. The ratings take into account mainly the characteristics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of soils, or present distribution of wildlife and people. For this reason, selection of the site for development as a habitat for wildlife requires inspection at the site.

[3] By CHARLES HAENISCH, agronomist, Soil Conservation Service.

TABLE 3.—*Suitability of the soils for elements of wildlife habitat and kinds of wildlife*

| Soil series and map symbols | Elements of wildlife habitat | | | | Kinds of wildlife | |
|---|---|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous plants | Shrubs | Open-land | Rangeland |
| Amarillo: AfA, AfB, AfC | Fair | Fair | Fair | Fair | Fair | Fair. |
| Berda: | | | | | | |
| BeB, BeC, BeD | Fair | Fair | Fair | Fair | Fair | Fair. |
| BoE, BPG | Poor | Fair | Fair | Fair | Fair | Fair. |
| For Paloduro part of BoE, see Paloduro series; for Potter part of BPG, see Potter series. | | | | | | |
| Bippus: | | | | | | |
| BtA | Good | Good | Good | Good | Good | Good. |
| Bw | Poor | Fair | Good | Good | Fair | Good. |
| Drake: DrB, DrC | Fair | Fair | Fair | Fair | Fair | Fair. |
| Estacado: EsA, EsB | Fair | Fair | Fair | Fair | Fair | Fair. |
| Flomot: | | | | | | |
| FoB, FoC | Fair | Fair | Fair | Fair | Fair | Fair. |
| FoD | Poor | Fair | Fair | Fair | Fair | Fair. |
| Latom: LaE | Poor | Poor | Poor | Poor | Poor | Poor. |
| For Rock outcrop part of LaE, see Rock outcrop. | | | | | | |
| Likes: LkD | Poor | Fair | Good | Fair | Fair | Fair. |
| Lincoln: Ln | Very poor | Poor | Fair | Fair | Poor | Fair. |
| Lofton: Lo | Fair | Fair | Fair | Fair | Fair | Fair. |
| Mansker: MaB, MaC | Fair | Fair | Fair | Fair | Fair | Fair. |
| Mobeetie: MoB | Fair | Fair | Fair | Fair | Fair | Fair. |
| Obaro: ObD | Poor | Fair | Good | Fair | Fair | Fair. |
| For Quinlan part of ObD, see Quinlan series. | | | | | | |
| Olton: OtA, OtB | Fair | Fair | Fair | Fair | Fair | Fair. |
| Paloduro: | | | | | | |
| PaA | Fair | Fair | Fair | Fair | Fair | Fair. |
| Paloduro part of BoE and PdG | Poor | Fair | Fair | Fair | Fair | Fair. |
| Polar: PdG | Poor | Poor | Fair | Fair | Poor | Fair. |
| For Paloduro part of PdG, see Paloduro series. | | | | | | |
| Portales: PmA | Fair | Fair | Fair | Fair | Fair | Fair. |
| Posey: PsD | Poor | Fair | Fair | Fair | Fair | Fair. |
| For Tulia part of PsD, see Tulia series. | | | | | | |
| Potter: PtE | Very poor | Very poor | Poor | Very poor | Very poor | Very poor. |
| Pullman: PuA, PuB | Fair | Fair | Fair | Fair | Fair | Fair. |
| Quinlan | Poor | Poor | Fair | Poor | Poor | Poor. |
| Mapped only with Obaro soils. | | | | | | |
| Randall: Ra | Very poor | Poor | Poor | Very poor | Poor | Very poor. |
| Rock outcrop | Very poor | Very poor | Poor | Very poor | Very poor | Very poor. |
| Mapped only with Latom soils. | | | | | | |
| Springer: SpD | Poor | Fair | Good | Poor | Fair | Fair. |
| Tulia | Poor | Fair | Fair | Fair | Fair | Fair. |
| Mapped only with Posey soils. | | | | | | |

The elements of wildlife habitat rated in table 3 are briefly described in the following paragraphs.

*Grain and seed crops* are crops that produce annual grain, such as corn, sorghum, millet, and soybeans.

*Grasses and legumes* are domestic grasses and legumes that are established by planting. They provide food and cover for wildlife. Grasses include bahiagrass, ryegrass, and panicgrass; legumes include annual lespedeza, shrub lespedeza, and other clovers.

*Wild herbaceous plants* are native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland wildlife. Beggarweed, perennial lespedeza, wildbean, pokeweed, and cheatgrass are examples of these plants. On range typical plants are bluestem, grama, perennial forbs, and legumes.

*Shrubs* are woody plants that produce wildlife food in the form of fruits, nuts, buds, or browse. Such plants commonly grow in their natural environment, but they may be planted and developed through wildlife management programs. Typical kinds of plants in the category are mesquite, dogweed, catclaw acacia, and shinnery oak.

*Wetland food and cover plants* are annual and perennial herbaceous plants that grow wild on moist and wet sites. They furnish food and cover mostly for wetland wildlife. Typical examples of plants are smartweed, wild millet, spikerush and other rushes, sedges, burreed, tearthumb, and aneilema. Submerged and floating aquatics are not included in this category. This column was not included in the table, since all the soils rate very poor to poor except Randall, which rates good.

*Shallow water developments* are impoundments or excavations for controlling water, generally not more than 5 feet deep, to create habitats that are suitable for waterfowl. Some are designed to be drained, planted, and then flooded; others are permanent impoundments that grow submersed aquatics. This column was not included in the table, since all the soils rate very poor to poor except Lofton soil, which rates fair, and Randall soil, which rates good.

Table 3 also rates soils according to their suitability as habitat for such kinds of wildlife in the county as open-land, rangeland, and wetland wildlife. These ratings are related to ratings made for the elements of wildlife habitat. For example, soils rated very poor for shallow water developments are rated very poor for wetland wildlife.

The kinds of wildlife rated in table 3 are briefly described in the following paragraphs.

*Open-land wildlife* are birds and mammals that normally live in meadows, pastures, and open areas where grasses, herbs, and shrubby plants grow. Quail, dove, meadowlark, field sparrow, cottontail rabbit, and fox are typical examples of open-land wildlife.

*Rangeland wildlife* are birds and mammals that normally live in open areas of grassland and shrubs. Coyote, fox, wild turkey, quail, deer, pronghorn antelope, and aoudad are typical examples of rangeland wildlife (fig. 22).

*Wetland wildlife* are birds and mammals that normally live in wet areas, marshes, and swamps. Ducks, geese, rail, shore birds, heron, mink, and muskrat are typical examples of wetland wildlife. This column was not included in the table, since all the soils rate poor to very poor except Randall soil, which rates good.

## Recreational Development

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 4 the soils of Floyd County are rated according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails.

***Figure 22.*—Turkeys on range in an area of Paloduro soils, 3 to 30 percent slopes.**

The soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these activities is required.

*Camp areas* are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have a mild slope, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

*Picnic areas* are attractive natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are free of flooding during the season of use, and do not have slope or stoniness that greatly increases cost of leveling sites or of building access roads.

*Playgrounds* are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

*Paths and trails* are used for local and cross-country travel by foot or on horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have a slope of less than 15 percent, and have few or no rocks or stones on the surface.

## Windbreaks [4]

Tree windbreaks are a valuable asset on farms and ranches. They are used to protect farmsteads, soil, crops, and livestock against damaging winds and blowing dust. They also provide food, cover, and nesting for many kinds of birds and other wildlife.

In Floyd County, windbreaks are used mainly for farmstead protection. Trees grow successfully on the major soils in the county if careful consideration is

[4] By ROBERT J. FEWIN, silviculturist, Texas Forest Service.

TABLE 4.—*Degree of limitation and soil features affecting recreational development*

[Certain terms used to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and other terms used to rate soils]

| Soil series and map symbols | Camp areas | Picnic areas | Playgrounds | Paths and trails |
|---|---|---|---|---|
| Amarillo: | | | | |
| AfA | Slight | Slight | Slight | Slight. |
| AfB, AfC | Slight | Slight | Moderate: slope | Slight. |
| Berda: | | | | |
| BeB, BeC | Slight | Slight | Moderate: slope | Slight. |
| BeD | Moderate: slope | Moderate: slope | Severe: slope | Slight. |
| BoE | Severe: slope | Severe: slope | Severe: slope | Moderate: slope. |
| For Paloduro part of BoE, see Paloduro series. | | | | |
| BPG | Severe: slope | Severe: slope | Severe: slope | Severe: slope. |
| For Potter part of BPG, see Potter series. | | | | |
| Bippus: | | | | |
| BtA | Moderate: too clayey | Moderate: too clayey | Moderate: too clayey | Moderate: too clayey. |
| Bw | Severe: floods | Moderate: floods | Severe: floods | Moderate: floods. |
| Drake: DrB, DrC | Moderate: dusty | Moderate: dusty | Moderate: dusty; slope. | Moderate: dusty. |
| Estacado: EsA, EsB | Moderate: too clayey | Moderate: too clayey | Moderate: too clayey | Moderate: too clayey. |
| Flomot: | | | | |
| FoB, FoC | Slight | Slight | Moderate: slope | Slight. |
| FoD | Moderate: slope | Moderate: slope | Severe: slope | Slight. |
| Latom: LaE | Moderate: slope | Moderate: slope | Severe: depth to rock; slope. | Moderate: slope. |
| Rock outcrop part is too variable to rate. | | | | |
| Likes: LkD | Moderate: too sandy | Moderate: too sandy | Severe: slope | Moderate: too sandy. |
| Lincoln: Ln | Severe: floods | Moderate: floods | Severe: floods | Moderate: floods. |
| Lofton: Lo | Severe: percs slowly | Moderate: too clayey | Severe: percs slowly | Moderate: too clayey. |
| Mansker: MaB, MaC | Moderate: too clayey | Moderate: too clayey | Moderate: too clayey | Moderate: too clayey. |
| Mobeetie: MoB | Slight | Slight | Moderate: slope | Slight. |
| Obaro: ObD | Moderate: slope | Moderate: slope | Severe: slope | Slight. |
| For Quinlan part of ObD, see Quinlan series. | | | | |
| Olton: OtA, OtB | Moderate: percs slowly. | Moderate: too clayey | Moderate: percs slowly | Moderate: too clayey. |
| Paloduro: | | | | |
| PaA | Slight | Slight | Slight | Slight. |
| Paloduro part of BoE and PdG. | Moderate: slope | Moderate: slope | Severe: slope | Severe: slope. |
| Polar: PdG | Severe: slope | Severe: slope | Severe: slope | Severe: slope. |
| For Paloduro part of PdG, see Paloduro series. | | | | |
| Portales: PmA | Moderate: dusty | Moderate: dusty | Moderate: dusty | Slight. |
| Posey: PsD | Moderate: slope | Moderate: slope | Severe: slope | Slight. |
| For Tulia part of PsD, see Tulia series. | | | | |
| Potter: PtE | Severe: slope | Severe: slope | Severe: slope | Moderate: slope. |
| Pullman: PuA, PuB | Moderate: percs slowly; too clayey. | Moderate: too clayey | Moderate: percs slowly; too clayey. | Moderate: too clayey. |
| Quinlan | Moderate: slope | Moderate: slope | Severe: depth to rock | Slight. |
| Mapped only with Obaro soils. | | | | |
| Randall: Ra | Severe: too clayey; wet. | Severe: too clayey | Severe: too clayey; wet. | Severe: too clayey. |
| Rock outcrop. | | | | |
| Mapped only with Latom soils. | | | | |
| Springer: SpD | Moderate: too sandy | Moderate: too sandy | Severe: slope | Moderate: too sandy. |
| Tulia | Moderate: slope | Moderate: slope | Severe: slope | Slight. |
| Mapped only with Posey soils. | | | | |

given to the kinds of trees selected. Olton and Pullman soils are the most productive for trees. Deciduous trees that are adapted to these soils are Siberian elm, Russian-olive, honeylocust, green ash, and osageorange. Coniferous trees that are adapted are oriental arborvitae, eastern redcedar, Rocky Mountain juniper, Arizona cypress, Austrian pine, and ponderosa pine. Estacado and Mansker soils have physical characteristics that restrict the growth of pines and green ash. Drake soils are calcareous loams that are somewhat droughty; however, Siberian elm, osageorange, oriental arborvitae, and eastern redcedar trees grow on them.

The vigorous growth and effectiveness of a windbreak depend greatly upon such factors as supplemental watering, site preparation, and maintenance and spacing of trees. Any tree or shrub, regardless of size or age, must be watered immediately after planting and at frequent intervals thereafter for the first year. Once established, trees can survive and grow well if they are watered during periods of low rainfall. It is desirable to summer-fallow the area to be planted to trees if the soil is not highly erodible. Weeds competition must be kept at a minimum at all times.

Traditionally, farmstead windbreaks consist of five or more rows of trees and shrubs, but a three-row windbreak seems to be the most practical. A three-row windbreak is an effective barrier against the prevailing wind when planted about 75 feet from the northern and western side of the area to be protected. A three-row windbreak should contain at least two kinds of coniferous trees. If a two-row or a one-row windbreak is used, Arizona cypress, Rocky Mountain juniper, eastern redcedar, or oriental arborvitae trees should be planted.

Proper spacing of trees within rows and between rows contributes considerably to the longevity of a windbreak. Coniferous trees require a spacing of 12 to 14 feet within a row, and deciduous trees require a spacing of 16 to 18 feet. Russian-olive trees can be planted at intervals of 10 to 12 feet. Weeds can easily be controlled when the tree rows are spaced 20 feet apart by using regular farm equipment.

Additional information on the layout and planting of a windbreak can be obtained from the offices of the Soil Conservation Service, the Texas Forest Service, and the County Extension Agent. These offices can also supply information on where seedlings of good quality can be obtained.

## Engineering Uses of the Soils[5]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among the soil properties most important in engineering are permeability, shear strength, compressibility, compaction characteristics, soil drainage condition, shrink-swell potential, grain-size distribution, plasticity, and reaction. Depth to the water table, depth to bedrock, and slope are also important. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 5 and 6 which show, respectively, several estimated soil properties significant to engineering and interpretations for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 5 and 6, and it also can be used to make other useful maps.

This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to a greater depth than those shown in the tables, generally a depth greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have different meanings in soil science than in engineering. Many of the terms commonly used in soil science are defined in the Glossary.

### *Engineering classification systems*

The two systems most commonly used in classifying samples of soils for engineering are the Unified soil classification system (*2*) used by SCS engineers, Department of Defense, and others, and the AASHTO system, adopted by the American Association of State Highway and Transportation Officials (*1*).

In the Unified soil classification system soils are classified according to particle-size distribution, plasticity index, liquid limit, and organic-matter content.

[5] Y. E. McADAMS, area engineer, Soil Conservation Service assisted in preparing this section.

TABLE 5.—*Estimates of soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The instructions for referring to other series that appear in the first column of

| Soil series and map symbols | Hydrologic group | Depth to bedrock | Depth from surface | Dominant USDA texture | Classification: Unified | Classification: AASHTO | Coarse fraction greater than 3 inches |
|---|---|---|---|---|---|---|---|
| | | *In* | *In* | | | | *Pct* |
| Amarillo: AfA, AfB, AfC | B | >60 | 0–9 | Fine sandy loam | SM or SM-SC | A–4 or A–2 | |
| | | | 9–40 | Sandy clay loam | SC or CL or SM-SC, CL-ML | A–6, A–4 | |
| | | | 40–84 | Sandy clay loam | SC or CL | A–6, A–4 | |
| *Berda: BeB, BeC, BeD, BoE, BPG. For Paloduro part of BoE, see Paloduro series; for Potter part of BPG, see Potter series. | B | >60 | 0–62 | Loam | CL or SC | A–4 or A–6 | |
| Bippus: BtA, Bw | B | >60 | 0–66 | Clay loam and sandy clay loam. | CL or ML, CL-ML | A–4 or A–6 | |
| Drake: DrB, DrC | B | >60 | 0–60 | Loam or clay loam | SC or CL | A–4 or A–6 | |
| Estacado: EsA, EsB | B | >60 | 0–15 | Clay loam | CL | A–6 | |
| | | | 15–26 | Clay loam | CL | A–6 or A–7–6 | |
| | | | 26–82 | Clay loam and silty clay loam. | CL | A–6 or A–7–6 | |
| Flomot: FoB, FoC, FoD | B | >60 | 0–7 | Fine sandy loam | SM or SM-SC | A–2–4 or A–4 | |
| | | | 7–37 | Loam | CL-ML, CL, SC, or SM-SC | A–4 or A–6 | |
| | | | 37–70 | Loam | CL-ML, CL, SC, or SM-SC | A–4 or A–6 | |
| Latom: LaE. Rock outcrop part is too variable to rate. | D | 4–16 | 0–16 | Fine sandy loam | SM-SC or SM | A–2–4 or A–4 | 0–5 |
| | | | 16–25 | Strong cemented calcareous sandstone. | | | |
| Likes: LkD | A | >60 | 0–26 | Loamy fine sand | SM or SM-SC, SP-SM | A–2–4, A–3 | |
| | | | 26–60 | Fine sand | SM or SM-SC, SP-SM | A–2–4, A–3 | |
| Lincoln: Ln | A | >60 | 0–14 | Fine sandy loam | SM | A–4 | |
| | | | 14–65 | Fine sand | SM | A–2 | |
| Lofton: Lo | D | >60 | 0–7 | Clay loam | CL | A–6 or A–7–6 | |
| | | | 7–73 | Clay | CL or CH | A–7 | |
| | | | 73–86 | Silty clay | CL | A–6 or A–7–6 | |

*significant in engineering*

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the this table. The symbol > means more than, the symbol < means less than]

| Percentage passing sieve— No. 4 (4.7 mm) | No. 10 (2.0 mm) | No. 40 (0.42 mm) | No. 200 (0.074 mm) | Liquid limit | Plasticity index | Permeability | Available water capacity | Reaction | Shrink-swell potential | Corrosivity to uncoated steel |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *Pct* | | *In per hr* | *In per in of soil* | *pH* | | |
| | 100 | 95–100 | 35–50 | 17–25 | 2–6 | 2.0–6.0 | 0.11–0.15 | 6.6–7.8 | Low | Moderate. |
| | 100 | 95–100 | 36–65 | 25–36 | 7–20 | 0.6–2.0 | 0.15–0.17 | 7.4–8.4 | Low | Moderate. |
| 90–100 | 90–100 | 80–95 | 36–60 | 20–32 | 8–15 | 0.6–2.0 | 0.11–0.15 | 7.9–8.4 | Low | Moderate. |
| 90–100 | 90–100 | 80–95 | 36–70 | 20–35 | 8–20 | 0.6–2.0 | 0.14–0.17 | 7.9–8.4 | Low | Moderate. |
| 100 | 95–100 | 80–100 | 51–85 | 25–40 | 7–20 | 0.6–2.0 | 0.16–0.20 | 7.9–8.4 | Low | Moderate. |
| | 100 | 70–90 | 40–70 | 20–35 | 9–15 | 0.6–2.0 | 0.10–0.15 | 7.9–8.4 | Low | High. |
| 100 | 98–100 | 95–100 | 51–85 | 25–40 | 11–25 | 0.6–2.0 | 0.14–0.18 | 7.9–8.4 | Low | Moderate. |
| 95–100 | 95–100 | 85–100 | 55–90 | 30–42 | 11–25 | 0.6–2.0 | 0.12–0.16 | 7.9–8.4 | Low | Moderate. |
| 95–100 | 95–100 | 95–100 | 60–95 | 30–45 | 15–25 | 0.6–2.0 | 0.13–0.17 | 7.9–8.4 | Low | Moderate. |
| 95–100 | 95–100 | 85–95 | 30–50 | 15–25 | 3–7 | 2.0–6.0 | 0.10–0.14 | 7.9–8.4 | Low | Moderate. |
| 90–100 | 80–98 | 75–95 | 36–70 | 20–35 | 5–15 | 0.6–2.0 | 0.10–0.15 | 7.9–8.4 | Low | Moderate. |
| 95–100 | 90–100 | 80–95 | 40–75 | 20–35 | 5–15 | 0.6–2.0 | 0.10–0.16 | 7.9–8.4 | Low | Moderate. |
| 90–100 | 85–95 | 80–90 | 25–45 | <25 | [1] NP–7 | 0.6–2.0 | 0.10–0.14 | 7.9–8.4 | Very low | Low. |
| 90–98 | 90–98 | 75–95 | 10–30 | <25 | NP–6 | 2.0–6.0 | 0.06–0.10 | 7.4–8.4 | Very low | Low. |
| 90–98 | 90–98 | 95–97 | 9–20 | <25 | NP–6 | 6.0–20 | 0.05–0.08 | 7.9–8.4 | Very low | Low. |
| | 100 | 50–90 | 36–50 | | NP | 6.0–20 | 0.06–0.09 | 7.9–8.4 | Very low | Very low. |
| 100 | 90–100 | 50–90 | 15–35 | | NP | 6.0–20 | 0.04–0.06 | 7.9–8.4 | Very low | Very low. |
| | 100 | 98–100 | 70–90 | 35–45 | 15–25 | 0.2–0.6 | 0.16–0.20 | 7.4–8.4 | Moderate | High. |
| | 100 | 95–100 | 70–90 | 45–55 | 20–30 | <0.06 | 0.16–0.20 | 7.4–8.4 | High | High. |
| 100 | 95–100 | 90–100 | 60–80 | 35–45 | 15–25 | 0.06–0.2 | 0.12–0.16 | 7.9–8.4 | Moderate | High. |

TABLE 5.—*Estimates of soil properties*

| Soil series and map symbols | Hydrologic group | Depth to bedrock | Depth from surface | Dominant USDA texture | Classification | | Coarse fraction greater than 3 inches |
|---|---|---|---|---|---|---|---|
| | | | | | Unified | AASHTO | |
| | | *In* | *In* | | | | *Pct* |
| Mansker: MaB, MaC | B | >60 | 0–14 | Clay loam | CL-ML, CL, SM-SC, SC | A–4 or A–6 | |
| | | | 14–35 | Clay loam | CL or SC | A–4 or A–6 | |
| | | | 35–75 | Clay loam | CL | A–4 or A–6 | |
| Mobeetie: MoB | B | >60 | 0–72 | Fine sandy loam and loamy fine sand. | SM-SC, CL-ML, ML or SM | A–4 | 0–5 |
| *Obaro: ObD For Quinlan part, see Quinlan series. | B | 20–42 | 0–34 | Loam | CL-ML, CL | A–4 or A–6 | |
| | | | 34–60 | Weakly cemented sandstone. | ML or CL-ML | A–4 | |
| Olton: OtA, OtB | C | >60 | 0–9 | Clay loam | CL | A–4 or A–6 | |
| | | | 9–44 | Clay and clay loam | CL | A–6 or A–7 | |
| | | | 44–84 | Clay loam | CL | A–6 | |
| Paloduro: PaA | B | >60 | 0–64 | Loam and fine sandy loam. | CL or SC | A–4 or A–6 | |
| *Polar: PdG For Paloduro part, see Paloduro series. | B | >60 | 0–8 | Gravelly sandy loam. | GM-GC, GM, SM, SM-SC | A–1, A–2 | 0–5 |
| | | | 8–60 | Very gravelly sandy loam and very gravelly loamy sand. | GM-GC, GP-GM, or SM, SP-SM | A–1, A–2 | 0–5 |
| Portales: PmA | B | >60 | 0–27 | Loam | CL | A–4 | |
| | | | 27–64 | Clay loam and sandy clay loam. | SC or CL | A–4 or A–6 | |
| *Posey: PsD For Tulia part, see Tulia series. | B | >60 | 0–8 | Loam | CL-ML, CL, ML, SM, or SC, SM-SC | A–4 | |
| | | | 8–80 | Clay loam | CL or ML | A–4 or A–6 | |
| Potter: PtE | C | 4–12 | 0–6 | Loam | ML or CL | A–4 or A–6 | |
| | | | 6–25 | Caliche fragments | GM, GC, SM, SC | A–2, A–4 or A–6 | |
| Pullman: PuA, PuB | D | >60 | 0–8 | Clay loam | CL | A–7, A–6 | |
| | | | 8–46 | Clay | CL or CH | A–7 | |
| | | | 46–86 | Clay loam | CL | A–7–6, A–6 | |
| Quinlan Mapped only with Obaro soils. | C | 10–20 | 0–18 | Loam | CL-ML or CL | A–4 | |
| | | | 18–60 | Weakly cemented sandstone. | | | |
| Randall: Ra | D | >60 | 0–100 | Clay | CH or CL | A–7 | |

*significant in engineering*—Continued

| Percentage passing sieve— No. 4 (4.7 mm) | No. 10 (2.0 mm) | No. 40 (0.42 mm) | No. 200 (0.074 mm) | Liquid limit | Plasticity index | Perme-ability | Available water capacity | Reaction | Shrink-swell potential | Corrosivity to uncoated steel |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *Pct* | | *In per hr* | *In per in of soil* | *pH* | | |
| 95–100 | 95–100 | 80–95 | 36–70 | 20–35 | 5–20 | 0.6–2.0 | 0.14–0.18 | 7.9–8.4 | Low | Moderate. |
| 90–100 | 90–100 | 85–95 | 40–80 | 20–35 | 8–20 | 0.6–2.0 | 0.10–0.12 | 7.9–8.4 | Low | Moderate. |
| 100 | 95–100 | 90–95 | 51–80 | 25–40 | 10–25 | 0.6–2.0 | 0.14–0.18 | 7.9–8.4 | Low | Moderate. |
| 95–98 | 90–95 | 85–95 | 40–65 | 18–25 | 2–7 | 2.0–6.0 | 0.10–0.13 | 7.9–8.4 | Very low | Low. |
| 95–98 | 92–95 | 90–95 | 75–85 | 25–35 | 7–15 | 0.6–2.0 | 0.12–0.16 | 7.9–8.4 | Low | Low. |
| 95–99 | 90–99 | 90–98 | 60–75 | 20–26 | 2–6 | 0.6–2.0 | 0.04–0.08 | 7.9–8.4 | Low | Low. |
| 100 | 95–100 | 85–100 | 55–75 | 20–35 | 10–20 | 0.6–2.0 | 0.15–0.20 | 6.6–7.8 | Low | Moderate. |
| 100 | 90–100 | 90–100 | 70–85 | 35–50 | 20–35 | 0.2–0.6 | 0.15–0.20 | 7.4–8.4 | Moderate | Moderate. |
| 90–100 | 90–100 | 90–100 | 60–75 | 25–40 | 15–30 | 0.2–0.6 | 0.10–0.15 | 7.9–8.4 | Moderate | Moderate. |
| 95–100 | 95–100 | 80–95 | 40–60 | 20–35 | 8–20 | 0.6–2.0 | 0.14–0.17 | 7.9–8.4 | Low | Moderate. |
| 45–75 | 35–60 | 30–50 | 10–25 | 10–15 | 2–7 | 2.0–6.0 | 0.04–0.09 | 7.9–8.4 | Very low | Very low. |
| 40–70 | 30–65 | 20–45 | 5–20 | <20 | NP–5 | 2.0–6.0 | 0.03–0.07 | 7.9–8.4 | Very low | Very low. |
| 100 | 95–100 | 85–95 | 51–65 | 15–25 | 8–10 | 0.6–2.0 | 0.14–0.17 | 7.9–8.4 | Low | Low. |
| 95–100 | 90–95 | 80–90 | 45–60 | 25–35 | 8–17 | 0.6–2.0 | 0.10–0.12 | 7.9–8.4 | Moderate | Low. |
| 98–100 | 95–100 | 85–95 | 36–70 | 20–35 | 3–10 | 0.6–2.0 | 0.13–0.17 | 7.9–8.4 | Low | Moderate. |
| 95–100 | 90–95 | 85–95 | 51–75 | 25–40 | 8–15 | 0.6–2.0 | 0.12–0.16 | 7.9–8.4 | Low | Moderate. |
| 80–95 | 70–90 | 60–85 | 51–70 | 30–40 | 5–15 | 0.6–2.0 | 0.12–0.15 | 7.9–8.4 | Low | Moderate. |
| 30–80 | 25–75 | 20–60 | 13–49 | 30–40 | 5–15 | 0.6–2.0 | 0.01–0.04 | 7.9–8.4 | Very low | Moderate. |
| | 100 | 95–100 | 70–90 | 35–50 | 15–30 | 0.2–0.6 | 0.14–0.18 | 6.6–8.4 | Moderate | High. |
| | 100 | 95–100 | 80–95 | 45–60 | 25–35 | <0.06 | 0.12–0.16 | 7.4–8.4 | High | High. |
| 95–100 | 90–100 | 90–100 | 80–95 | 35–50 | 20–30 | 0.06–0.2 | 0.12–0.16 | 7.9–8.4 | Moderate | High. |
| | 100 | 90–100 | 55–85 | 20–30 | 4–10 | 2.0–6.0 | 0.12–0.16 | 7.9–8.4 | Low | Low. |
| | 100 | 96–100 | 70–95 | 41–65 | 30–40 | <0.06 | 0.14–0.18 | 6.6–8.4 | High | High. |

TABLE 5.—*Estimates of soil properties*

| Soil series and map symbols | Hydro-logic group | Depth to bedrock | Depth from surface | Dominant USDA texture | Classification: Unified | Classification: AASHTO | Coarse fraction greater than 3 inches |
|---|---|---|---|---|---|---|---|
| | | *In* | *In* | | | | *Pct* |
| Rock outcrop. Mapped only with Latom soils. | | | | | | | |
| Springer: SpD | B | >60 | 0–13 | Loamy fine sand | SM or SP-SM, SM-SC | A–2–4 or A–3 | |
| | | | 13–84 | Fine sandy loam and loamy fine sand. | SM or SM-SC | A–2–4 | |
| Tulia. Mapped only with Posey soils. | B | >60 | 0–9 | Loam | CL-ML, CL, SC or SM-SC | A–4 or A–6 | |
| | | | 9–48 | Clay loam | SC, CL | A–4 or A–6 | |
| | | | 48–64 | Clay loam | CL | A–6 or A–4 | |

[1] NP=Nonplastic.

TABLE 6.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. carefully the instructions for referring to other series that appear in the first column of this table. Certain terms used to other terms used to rate soils]

| Soil series and map symbols | Degree and kind of limitation for—: Septic tank absorption fields | Sewage lagoons | Shallow excavations | Dwellings without basements | Sanitary landfill [1] |
|---|---|---|---|---|---|
| Amarillo: AfA, AfB, AfC | Slight | Moderate: seepage. | Slight | Slight | Slight |
| *Berda: | | | | | |
| BeB | Slight | Moderate: seepage; slope. | Slight | Slight | Slight |
| BeC | Slight | Moderate: seepage; slope. | Slight | Slight | Slight |
| BeD | Moderate: slope. | Severe: slope | Moderate: slope. | Moderate: slope. | Slight |
| BoE. For Paloduro part of BoE, see Paloduro series. | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Moderate: slope. |
| BPG. For Potter part of BPG, see Potter series. | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope |
| Bippus: | | | | | |
| BtA | Slight | Moderate: seepage. | Moderate: too clayey. | Slight | Moderate: too clayey. |
| Bw | Severe: floods | Severe: floods | Severe: floods | Severe: floods | Severe: floods |
| Drake: DrB, DrC | Slight | Severe: seepage | Moderate: too clayey. | Moderate: low strength. | Moderate: too clayey. |

*significant in engineering*—Continued

| Percentage passing sieve— No. 4 (4.7 mm) | No. 10 (2.0 mm) | No. 40 (0.42 mm) | No. 200 (0.074 mm) | Liquid limit | Plasticity index | Permeability | Available water capacity | Reaction | Shrink-swell potential | Corrosivity to uncoated steel |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *Pct* | | *In per hr* | *In per in of soil* | *pH* | | |
| 100 | 95–100 | 70–85 | 8–25 | 15–20 | NP–4 | 6.0–20 | 0.06–0.10 | 6.6–7.8 | Very low | Low. |
| 100 | 95–100 | 80–95 | 12–35 | 17–23 | 2–7 | 2.0–6.0 | 0.06–0.14 | 7.4–8.4 | Low | Low. |
| 95–100 | 95–100 | 85–95 | 36–70 | 20–35 | 5–20 | 0.6–2.0 | 0.14–0.18 | 7.9–8.4 | Low | Moderate. |
| 90–100 | 90–100 | 85–95 | 40–80 | 20–35 | 9–15 | 0.6–2.0 | 0.07–0.12 | 7.9–8.4 | Low | Moderate. |
| 100 | 95–100 | 90–95 | 51–80 | 25–40 | 8–20 | 0.6–2.0 | 0.14–0.18 | 7.9–8.4 | Low | Moderate. |

*interpretations*

The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and

| Degree and kind of limitation for—Continued: Local roads and streets | Pond reservoir areas | Embankments, dikes, and levees | Suitability as a source of—: Road fill | Topsoil | Soil features affecting—: Irrigation | Terraces and diversions |
|---|---|---|---|---|---|---|
| Moderate: low strength. | Moderate: seepage. | Moderate: unstable fill. | Fair: low strength. | Fair: too sandy. | All features favorable. | All features favorable. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping; unstable fill. | Fair: low strength. | Fair: thin layer. | Erodes easily | Slope. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping; unstable fill. | Fair: low strength. | Fair: thin layer. | Erodes easily; slope. | Slope. |
| Moderate: slope. | Moderate: seepage. | Moderate: piping; unstable fill. | Fair: low strength. | Fair: slope; thin layer. | Slope | Slope. |
| Severe: slope | Moderate: seepage. | Moderate: piping; unstable fill. | Fair: slope | Poor: slope | Slope | Slope. |
| Severe: slope | Moderate: seepage. | Moderate: piping; unstable fill. | Poor: slope | Poor: slope | Slope | Slope. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping | Fair: low strength. | Fair | All features favorable. | Not needed. |
| Severe: floods | Moderate: seepage. | Moderate: piping | Fair: low strength. | Fair: too clayey. | Floods | Not needed. |
| Moderate: low strength. | Severe: seepage. | Moderate: piping. | Fair: low strength. | Fair: excess lime. | Erodes easily; excess lime. | Erodes easily. |

TABLE 6.—*Engineering*

| Soil series and map symbols | Degree and kind of limitation for— | | | | |
|---|---|---|---|---|---|
| | Septic tank absorption fields | Sewage lagoons | Shallow excavations | Dwellings without basements | Sanitary landfill [1] |
| Estacado: EsA, EsB | Slight | Moderate: seepage. | Moderate: too clayey. | Moderate: low strength. | Moderate: too clayey. |
| Flomot: | | | | | |
| FoB, FoC | Slight | Severe: seepage | Slight | Slight | Slight |
| FoD | Moderate: slope. | Severe: seepage; slope. | Moderate: slope. | Moderate: slope. | Slight |
| Latom: LaE. Rock outcrop part is too variable to rate. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. |
| Likes: LkD | Slight | Severe: seepage | Severe: too sandy. | Slight | Severe: seepage. |
| Lincoln: Ln | Severe: floods | Severe: floods; seepage. | Severe: floods | Severe: floods | Severe: floods |
| Lofton: Lo | Severe: percs slowly. | Slight | Severe: too clayey. | Severe: shrink-swell. | Severe: too clayey. |
| Mansker: | | | | | |
| MaB | Slight | Moderate: seepage. | Slight | Slight | Moderate: too clayey. |
| MaC | Slight | Moderate: seepage; slope. | Slight | Slight | Moderate: too clayey. |
| Mobeetie: MoB | Slight | Severe: seepage | Slight | Slight | Severe: seepage. |
| *Obaro: ObD. For Quinlan part, see Quinlan series. | Severe: depth to rock. | Severe: depth to rock. | Moderate: depth to rock. | Slight | Severe: depth to rock. |
| Olton: OtA, OtB | Moderate: percs slowly. | Slight | Slight | Moderate: low strength; shrink-swell. | Moderate: too clayey. |
| Paloduro: | | | | | |
| PaA | Slight | Moderate: seepage. | Slight | Moderate: low strength. | Slight |
| Paloduro part of BoE and PdG. | Moderate: slope. | Severe: slope | Moderate: slope. | Moderate: low strength. | Moderate: slope. |
| *Polar: PdG. For Paloduro part, see Paloduro series. | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope |
| Portales: PmA | Slight | Moderate: seepage. | Slight | Slight | Slight |
| *Posey: PsD. For Tulia part, see Tulia series. | Moderate: slope. | Severe: slope | Moderate: slope. | Moderate: slope. | Slight |
| Potter: PtE | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: seepage. |
| Pullman: PuA, PuB | Severe: percs slowly. | Slight | Severe: too clayey. | Severe: shrink-swell. | Severe: too clayey. |
| Quinlan. Mapped only with Obaro soils. | Severe: depth to rock. | Severe: depth to rock. | Moderate: depth to rock. | Moderate: depth to rock; slope. | Moderate: depth to rock. |
| Randall: Ra | Severe: percs slowly. | Slight | Severe: floods; too clayey. | Severe: floods; too clayey. | Severe: floods; too clayey. |

*interpretations*—Continued

| Degree and kind of limitation for—Continued | | | Suitability as a source of— | | Soil features affecting— | |
|---|---|---|---|---|---|---|
| Local roads and streets | Pond reservoir areas | Embankments, dikes, and levees | Road fill | Topsoil | Irrigation | Terraces and diversions |
| Moderate: low strength. | Moderate: seepage. | Fair: piping | Fair: low strength. | Fair: too clayey. | All features favorable. | All features favorable. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping | Fair: low strength. | Fair: excess lime. | Droughty | Erodes easily. |
| Moderate: low strength; slope. | Moderate: seepage. | Moderate: piping | Fair: low strength. | Fair: excess lime. | Droughty; slope. | Erodes easily; slope. |
| Severe: depth to rock. | Severe: depth to rock. | Severe: erodes easily; thin layer. | Poor: thin layer. | Fair: thin layer. | Droughty; slope. | Depth to rock; slope. |
| Slight | Severe: seepage. | Moderate: piping | Good | Poor: too sandy. | Droughty; erodes easily. | Not needed. |
| Severe: floods | Severe: seepage. | Moderate: piping | Good | Poor: too sandy. | Floods | Not needed. |
| Severe: shrink-swell. | Slight | Moderate: unstable fill. | Poor: shrink-swell. | Poor: too clayey. | All features favorable. | Percs slowly. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping | Fair: low strength. | Fair: excess lime. | Excess lime | All features favorable. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping | Fair: low strength. | Fair: excess lime. | Excess lime; slope. | Slope. |
| Moderate: low strength. | Severe: seepage. | Moderate: piping | Fair: low strength. | Good | Erodes easily; seepage. | Erodes easily. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping | Fair: low strength. | Fair: slope | Rooting depth; slope. | Rooting depth; slope. |
| Severe: low strength. | Moderate: seepage. | Moderate: piping | Poor: low strength. | Fair: too clayey. | All features favorable. | All features favorable. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping | Fair: low strength. | Good | All features favorable. | All features favorable. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping | Fair: low strength. | Fair: slope | Slope | Slope. |
| Severe: slope | Severe: seepage. | Moderate: piping | Severe: slope | Severe: slope | Slope | Slope. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping | Fair: low strength. | Good | All features favorable. | All features favorable. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping | Fair: low strength. | Fair: slope; thin layer. | Slope | Slope. |
| Severe: slope | Severe: seepage. | Severe: thin layer. | Fair: low strength. | Poor: excess lime; slope. | Droughty; slope. | Slope. |
| Severe: shrink-swell. | Slight | Moderate: piping | Poor: shrink-swell. | Fair: too clayey. | All features favorable. | All features favorable. |
| Moderate: depth to rock; slope. | Severe: depth to rock. | Severe: thin layer. | Poor: depth to rock. | Fair: thin layer. | Rooting depth; slope. | Depth to rock. |
| Severe: shrink-swell. | Slight | Moderate: unstable fill. | Poor: shrink-swell. | Poor: too clayey. | Floods | Not needed. |

TABLE 6.—*Engineering*

| Soil series and map symbols | Degree and kind of limitation for— | | | | |
|---|---|---|---|---|---|
| | Septic tank absorption fields | Sewage lagoons | Shallow excavations | Dwellings without basements | Sanitary landfill [1] |
| Rock outcrop. Mapped only with Latom soils. | | | | | |
| Springer: SpD | Slight | Severe: seepage | Severe: cutbanks cave. | Slight | Severe: seepage. |
| Tulia. Mapped only with Posey soils. | Moderate: slope. | Severe: slope | Moderate: slope; too clayey. | Moderate: low strength; slope. | Moderate: too clayey. |

[1] Onsite study is needed of the deep underlying strata, the water table, and the hazards of aquifer pollution and drainage into

Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes, for example CL-ML. The letters used in class designation mean: G, gravel; S, sand; M, silt; and C, clay. Clean sands are identified by SW or SP; sands that have fines of silt and clay by SM or SC; silt and clay that have a low liquid limit by ML and CL; and silt and clay that have a high liquid limit by MH and CH.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and pasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6.

### *Estimated properties*

Several estimated soil properties significant to engineering are given in table 5. These estimates are made for typical soil profiles, by layers sufficiently different to behave in a different way when used for engineering purposes. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. In the following paragraphs the columns in table 5 are explained.

In the column headed "Hydrologic group," the runoff potential from rainfall is given. Four major soil groups are used, and the soils are classified on the basis of intake of water at the end of long-duration storms that occur after prior wetting and opportunity for swelling and without the protective effects of vegetation.

The major soil groups are described in the following paragraphs.

Group A consists of soils that have a high infiltration rate even when thoroughly wetted. These are chiefly deep, well-drained to excessively drained sand, gravel, or both. These soils have a high rate of water transmission and a low runoff potential.

Group B consists of soils that have a moderate infiltration rate when thoroughly wetted. These are chiefly moderately deep to deep, moderately well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission and a moderate runoff potential.

Group C consists of soils that have a slow infiltration rate when thoroughly wetted. These are chiefly soils that have a layer that impedes downward movement of water or soils that have moderately fine texture to fine texture. These soils have a slow rate of water transmission and a high runoff potential.

Group D consists of soils that have a very slow infiltration rate when thoroughly wetted. These are chiefly clay soils that have a high swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission and a very high runoff potential.

Depth to bedrock is the distance from the surface of the soil to the upper surface of the rock layer.

In the column headed "Depth from surface," the depth is given in inches for the major distinctive layers of the soil profile.

Soil texture, is described in table 5 in the standard terms used by the U.S. Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2.0

*interpretations*—Continued

| Degree and kind of limitation for—Continued | | | Suitability as a source of— | | Soil features affecting— | |
|---|---|---|---|---|---|---|
| Local roads and streets | Pond reservoir areas | Embankments, dikes, and levees | Road fill | Topsoil | Irrigation | Terraces and diversions |
| Slight | Severe: seepage. | Moderate: piping | Good | Poor: too sandy. | Droughty; seepage. | Erodes easily; too sandy. |
| Moderate: low strength. | Moderate: seepage. | Moderate: piping | Fair: low strength. | Fair: excess lime; slope. | Slope | Slope. |

ground water in landfill deeper than 5 or 6 feet.

millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," and other terms used in USDA textural classification are defined in the Glossary.

The percentages of soil material passing sieves of four sizes are given as the range of material passing sieves. This information is useful in helping to determine suitability of the soil as a material for construction purposes.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 5 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts. The ratings should not be confused with the coefficient of permeability or *k*-value, used by engineers.

Available water capacity is the ability of a soil to hold water for use by most plants. It commonly is defined as the numerical difference between the amount of water at the time most crop plants wilt. The rate is expressed as inches of water per inch of soil depth.

Reaction is the degree of acidity or alkalinity of a soil expressed as pH. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected of the soil material with changes in moisture content; that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates a hazard to the maintenance of structures built in, on, or of material having this rating.

Corrosivity, as used in table 5, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that the probability of soil-induced corrosion damage is low. A rating of *high* means that the probability of damage is high, so that protective measures for steel should be used to avoid or minimize damage.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years. This column was not included in the table, since a seasonal high water table is not a limitation except in Lincoln soils, which have a water table at a depth of 3 to 10 feet.

***Engineering interpretations***

The estimated interpretations in table 6 are based on the engineering properties of soils shown in table 5, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Floyd County. In table 6, ratings are used to summarize limitation or suitability of the soils for all listed purposes other

than for irrigation and terraces and diversions. For these particular uses, table 6 lists those soil features not to be overlooked in planning, installing, and maintaining structures.

Soil limitations are indicated by the ratings slight, moderate and severe. *Slight* means that soil properties are generally favorable for the rated use, or in other words, limitations that are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is rated by the terms *good, fair,* and *poor,* which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

In the following paragraphs the columns in table 6 are explained.

*Septic tank absorption fields* are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material between the depths of 18 inches and 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope affects the difficulty of layout and construction and also the risk of erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

*Sewage lagoons* are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. The assumptions are made that the embankment is compacted to medium density and that the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic-matter content, and slope; if the floor needs to be leveled, depth to bedrock is important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified soil classification system and the amounts of stones, if any, that influence the ease of excavation and compaction of the embankment material.

*Shallow excavations* are those that require digging or trenching to a depth of less than 6 feet, such as excavations for pipelines, sewerlines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding and from a high water table.

*Dwellings without basements,* as rated in table 6, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

*Sanitary landfill* is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 6 apply only to a depth of about 6 feet; therefore, limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. Even though reliable predictions can be made to a depth of 10 or 15 feet for some soils, every site should be investigated before it is selected.

*Local roads and streets,* as rated in table 6, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly of asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep. Soil properties that most affect design and construction of roads and streets are load-supporting capacity, stability of the subgrade, and workability and quantity of cut and fill material available. The AASHTO and Unified classifications of their soil material as well as the shrink-swell potential indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect the ease of excavation and the amount of cut and fill needed to reach and even grade.

*Pond reservoir areas* hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and their depth to fractured or permeable bedrock or other permeable material.

*Embankments, dikes, and levees* require soil material that is resistant to seepage and piping and has favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are unfavorable factors.

*Road fill* is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of a soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

*Topsoil* is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or the response of plants grown on the soil when fertilizer is applied; and

absence of substances toxic to plants. Texture of the soil material and its content of stone fragments affect suitability. Damage to the area from which topsoil is taken is also considered in the rating. Excess lime refers to calcium carbonate equivalent of a soil. The percentage of calcium carbonate equivalent is given in the range of characteristics of those soils where this characteristic is important. A calcium carbonate equivalent greater than 15 percent will cause chlorosis in many plants. The chlorosis can be helped with the application of iron supplements and large amounts of organic residue. A calcium carbonate equivalent that exceeds 30 percent is impractical to correct for use as topsoil.

*Irrigation* of a soil is affected by such features as slope; susceptibility to stream overflow, erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

*Terraces and diversions* are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

*Sand and gravel* are used in great quantities in many kinds of construction. Ratings provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit. A column was not included in table 6, since the soils of Floyd County are not good sources of sand or gravel. Likes, Lincoln, and Springer soils are fair sources of sand, and Polar and Potter soils are fair sources of gravel.

*Drainage* of cropland and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage. A column was not included in the table. Drainage is no problem in soils in Floyd County, except for Randall soil, which is somewhat poorly drained.

# *Formation and Classification of the Soils*

The major factors of soil formation and how they have affected the soils of Floyd County are discussed in this section. The important processes in the development of soil horizons are briefly described. In addition, the current system of classifying soils is defined, and each soil series in the county is placed in the major categories of this system.

## Factors of Soil Formation

Soils are the product of the interaction of five major factors of soil formation. These factors are climate, living organisms (especially vegetation), parent material, relief (topography), and time. The kind of soil that forms in one area differs from the kind of soil formed in another area if the two areas are different in one or more of the major factors.

### *Climate*

Floyd County has a dry steppe climate and mild winters. The average rainfall is about 18.75 inches, but the amount varies greatly from year to year. The climate is uniform throughout the county, but its effects have been modified locally by relief and runoff, and the differences between the soils generally are not due to climate.

Because rainfall is low and there are long dry periods, soil development has been slow. Soils are seldom wet below the root zone, and as a result, most of the soils have a horizon of calcium carbonate accumulation. In Amarillo, Olton, and Pullman soils, the carbonates are leached from the surface layer. In Estacado, Mansker, and Potter soils, free lime is throughout the soil profile. Most soils have a layer of calcium carbonate or caliche at a depth of 1 foot to 5 feet. A few soils, such as Randall and Springer, do not have a caliche layer.

Winds played an important role in the development of the soils of Floyd County. Most of the parent material was laid down by wind during different periods of the geologic past. Even today, high winds deposit or remove soil particles. Winds also bring in calcium carbonate from other areas and recharge the soils with lime, thereby keeping the pH of soils high. Locally, high winds deposited soil materials on the eastern and southern sides of some of the large playa lakes in which the Drake soils formed.

Warm temperatures restrict the accumulation of large amounts of organic matter in most of the soils, although they formed under prairie vegetation where large amounts of organic matter is added each year. Oxidation processes use up most of the organic matter as it is added to the soil. Sandy soils such as Latom, Likes, and Springer are low in organic matter. Bippus, Lofton, and Pullman soils are highest in organic matter.

### *Living organisms*

Plants, animals, earthworms, and micro-organisms are important in the formation of soils. The type and amount of plant growth is related to the climate and parent material. The vegetation in Floyd County is mostly grass, some bushy plants, and small hardwood trees. The type of grasses that grow on a particular kind of soil depends partly on the parent material.

Short grasses grow on Pullman soils and similar soils that have a high clay content. Tall grasses grow on Springer soils and other sandy soils.

Prairie-type vegetation contributes large amounts of organic matter to the soils of the county. Grass leaves and stems fall on the surface and decay. Roots decompose and distribute organic matter throughout the profile and provide abundant food for earthworms and micro-organisms. Earthworm activity leaves the soil layers in a friable condition. Worm casts add greatly to the movement of air, water, and plant roots throughout the profile. Earthworm activity has been greatest in calcareous soils such as Bippus, Estacado, and Mansker soils. Pullman soils and other soils that have clayey lower layers show little earthworm activity.

Prairie dogs affect soil development by their burrowing activities. The animals churn and mix the soil material, which offsets the leaching of soluble minerals and destroys soil structure. Krotovinas, or soil-filled animal burrows, are common in the subsoil of most of the soils in the county. Such calcareous soils as Estacado and Mansker have more krotovinas than do most other soils.

***Parent material***

The kind of soil that forms in any given area depends mainly on the kind of parent material in that area. Parent material is the unconsolidated mass from which a soil is formed. It also determines the chemical and mineralogical composition of a soil.

The largest portion of the soils in Floyd County developed in the thick eolian mantle that blankets the county. This mantle, also referred to as "cover sands" (*4*), was deposited over the southern High Plains during the Pleistocene Epoch. The Pleistocene Epoch was marked by alternating wet and dry periods. During dry periods, high wind moved eolian material in from the southwest and deposited it in a uniform blanket across the southern High Plains. The eolian mantle is about 10 to 40 feet thick in most places. The material is mostly sandy clay loam, clay loam, and clay interbedded with layers of soft caliche. Lofton, Olton, and Pullman soils developed in this material. In areas that have more caliche or where caliche layers are closer to the surface, Estacado, Mansker, Posey, and Tulia soils developed.

Material along draws and in stream beds is more recent in age. Berda and Bippus soils formed in loamy material on the floor and the side slopes of draws. Lincoln soils formed in sandy material along streams in the area below the Caprock.

Randall soils formed in clayey material on the bottom of playa depressions. Estacado, Lofton, Mansker, and Portales soils formed in loamy material on the benches and side slopes around playa lakes. On the eastern and southern sides of some playa depressions, a ridge of loamy calcareous material was blown from the basins in Recent geologic time. Drake soils formed in the windblown material.

In part of the county the Ogallala Formation is exposed on the faces of the "rough breaks." Berda, Mobeetie, and Polar soils formed in this material or in colluvium that has eroded from this formation.

The top of the Ogallala Formation is the thick layer of caliche rock, or Caprock, that is prominent along the margin of the High Plains (*3*). Potter soils developed in this caliche. Triassic sediments known as the Dockum Group are exposed in parts of the county (*5*). Latom soils formed in material weathered from the sandstone. Permian material is also exposed in parts of the county. The Quartermaster Formation (Permian System) is characterized by red beds consisting of sandstone and shale (*5*) in which Obaro and Quinlan soils formed.

A mantle of outwash material was deposited over the Permian red beds during the Pleistocene Epoch. The outwash deposits range from a few feet to about 50 feet in thickness and are mainly sandy and loamy. Amarillo and Flomot soils formed in this material.

***Relief***

Relief, or lay of the land, influences the formation of soils through its effect on drainage, runoff, and erosion. The relief of Floyd County ranges from nearly level to steep.

If other factors of soil formation are equal, the degree of profile development depends largely on the moisture that enters and passes through the soil. Steep soils absorb less moisture and are more susceptible to erosion than are soils in more level areas. Therefore, most steep soils have a thinner, less developed profile.

Nearly level to gently sloping soils, such as Amarillo, Olton, and Pullman are well developed; therefore, relief has not been the limiting factor. Latom, Potter, and Quinlan soils have been strongly influenced by relief. These soils are steeper, and runoff and geologic erosion have been high. They have been able to develop only to a shallow depth.

Soils in low, concave areas also show the influence of relief upon their development. Bippus and Lofton soils are darker in color and higher in organic matter than are soils in higher areas because extra water has produced more vegetation in these low areas. Soils in poorly drained areas, such as Randall clay in playa depressions, show the influence that excessive water has on soil development.

***Time***

Time, normally a long time, is required for the formation of distinct horizons that a mature soil has. The differences in the length of time that parent material has been in place are generally reflected in the degree of development of the soil profile.

The soils in Floyd County are weakly developed to well developed. The weakly developed soils have little horizon development, and the well-developed soils have well expressed soil horizons. The weakly developed soils, such as Drake, Latom, Likes, and Lincoln, have been in place for a short time, and the soil horizons have only begun to form. Most of the development is in the surface layer, where organic matter has accumulated and parent material has been altered by vegetation, earthworms, and micro-organisms.

Berda, Bippus, and Mobeetie soils are intermediately

developed. These soils have weak horizon development, but no silicate clay has accumulated in the B horizon.

Amarillo, Olton, and Pullman soils are well developed in Floyd County. These soils have well-expressed horizons, and silicate clay has moved out of the surface horizon into the subsoil.

## Processes of Horizon Differentiation

The processes that have been active in the formation of horizons in the soils of Floyd County are (a) the accumulation of organic matter, (b) movement, or leaching, of calcium carbonate and bases to lower layers, and (c) formation and translocation of silicate clay minerals. In most soils in the county, more than one of these processes have been active.

The accumulation of organic matter in the upper layer to form an A1 horizon has been important in the soils. However, the soils in Floyd County are moderate to very low in organic-matter content because organic matter decomposes rapidly.

Leaching of carbonates and bases has occurred to some degree in nearly all of the soils. Leaching of bases in soils mostly precedes translocation of silicate clay minerals. This leaching contributed to the development of horizons. For example, Olton soils have been leached of most carbonates and bases and show distinct horizons of calcium carbonate accumulation in the lower part. In contrast, Mobeetie soils have not been leached to a great extent and have only slight accumulations of calcium carbonate in the lower part.

In many soils the downward translocation of clay minerals has contributed to horizon development. Amarillo, Olton, and Pullman soils have translocated silicate clays accumulated in the Bt horizons. The Bt horizons of these soils have more silicate clays than do their A horizons. These soils were probably leached of carbonates and soluble salts to a large extent before translocation of silicate clays took place. Leaching of bases and calcium carbonate and translocation of silicate clays are among the most important processes in horizon differentiation in the soils of Floyd County.

## Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (*7*). Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.[6]

The current system of classification has six categories. Beginning with the broadest, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 7, the soil series of Floyd County are placed in family, subgroup, and order according to the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ent-i-sol). The six orders of the soils of Floyd County are Alfisols, Aridisols, Entisols, Inceptisols, Mollisols, and Vertisols.

Alfisols have a light-colored surface layer that is low in organic matter, a clay-enriched B horizon, an accumulation of aluminum and iron, and a base saturation of more than 35 percent.

Aridisols have a light-colored surface layer that is low in organic matter and has inadequate moisture to mature a crop without irrigation in most years.

Entisols have little or no evidence of development of pedogenic horizons.

Inceptisols have a light-colored surface layer that is low in organic matter, but they lack a clay enriched B horizon.

Mollisols have a dark-colored surface layer that is high in organic matter, and they have a base saturation of more than 50 percent.

Vertisols are clayey soils that have deep, wide cracks during a part of each year in most years.

SUBORDER: Each order is divided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the order. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences that result from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Ustoll* (*Ust*, meaning of dry climate, and *oll* from Mollisol).

GREAT GROUP: Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, move-

[6] See the unpublished working document "Selected Chapters from the Unedited Text of the Soil Taxonomy" available in the SCS State Office, Temple, Texas.

ment of water, or both; and those that have thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplustolls (*Hapl*, meaning simple horizon, *ust* for dry climate, and *oll* from Mollisol).

SUBGROUP: Each great group is divided into subgroups, one representing the central (typic) segment of the group and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Cumulic Haplustolls.

FAMILY: Soil families are defined within a subgroup primarily on the basis of properties that affect the growth of plants or the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae as shown in table 7. An example is the fine-loamy, mixed, thermic family of Cumulic Haplustolls.

SERIES: The series consists of a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile. Bippus series is an example.

## *General Nature of the County*

This section provides information for those not familiar with the county. It describes the climate and its influences and gives a brief history of the settlement of Floyd County.

### Climate [7]

Floyd County has a dry steppe climate characterized by mild winters. Average annual precipitation is 18.75 inches. In an average year, 84 percent of the precipitation falls during the warm season, April through October. Monthly and annual amounts of precipitation are extremely variable. In 1941, the wettest year of record, 43.45 inches fell, which was eight times that of 1956, the driest year, when 5.32 inches fell. Warm season rainfall occurs most frequently during thunderstorms. In exceptionally wet years, a significant proportion of the total precipitation results from excessive downpours that run off rapidly and erode the soil. In an average year, thunderstorms occur on 44 days in Floyd County. Facts about temperature and precipitation are given in table 8.

The prevailing wind is southwesterly in November through April and southerly in May through October. Windspeed averages about 13.4 miles per hour. The average relative humidity at noon is estimated at 50 percent in January, 42 percent in April, 45 percent in July, and 46 percent in October.

[7] By ROBERT B. ORTON, climatologist for Texas, National Weather Service, U.S. Department of Commerce.

TABLE 7.—*Soil series classified according to the current system of classification*

| Series | Family | Subgroup | Order |
|---|---|---|---|
| Amarillo | Fine-loamy, mixed, thermic | Aridic Paleustalfs | Alfisols. |
| Berda | Fine-loamy, mixed, thermic | Aridic Ustochrepts | Inceptisols. |
| Bippus | Fine-loamy, mixed, thermic | Cumulic Haplustolls | Mollisols. |
| Drake | Fine-loamy, mixed (calcareous), thermic | Typic Ustorthents | Entisols. |
| Estacado | Fine-loamy, mixed, thermic | Calciorthidic Paleustolls | Mollisols. |
| Flomot | Coarse-loamy, carbonatic, thermic | Calciorthidic Paleustalfs | Alfisols. |
| Latom | Loamy, mixed (calcareous), thermic | Lithic Ustic Torriorthents | Entisols. |
| Likes | Mixed, thermic | Typic Ustipsamments | Entisols. |
| Lincoln | Sandy, mixed, thermic | Typic Ustifluvents | Entisols. |
| Lofton | Fine, mixed, thermic | Vertic Argiustolls | Mollisols. |
| Mansker | Fine-loamy, carbonatic, thermic | Calciorthidic Paleustolls | Mollisols. |
| Mobeetie | Coarse-loamy, mixed, thermic | Aridic Ustochrepts | Inceptisols. |
| Obaro | Fine-silty, mixed, thermic | Typic Ustochrepts | Inceptisols. |
| Olton | Fine, mixed, thermic | Aridic Paleustolls | Mollisols. |
| Paloduro | Fine-loamy, mixed, thermic | Aridic Haplustolls | Mollisols. |
| Polar | Loamy-skeletal, mixed, thermic | Ustollic Calciorthids | Aridisols. |
| Portales | Fine-loamy, mixed, thermic | Aridic Calciustolls | Mollisols. |
| Posey | Fine-loamy, mixed, thermic | Calciorthidic Paleustalfs | Alfisols. |
| Potter | Loamy, carbonatic, thermic, shallow | Ustollic Calciorthids | Aridisols. |
| Pullman | Fine, mixed, thermic | Torrertic Paleustolls | Mollisols. |
| Quinlan | Loamy, mixed, thermic, shallow | Typic Ustochrepts | Inceptisols. |
| Randall | Fine, montmorillonitic, thermic | Udic Pellusterts | Vertisols. |
| Springer | Coarse-loamy, mixed, thermic | Udic Paleustalfs | Alfisols. |
| Tulia | Fine-loamy, carbonatic, thermic | Calciorthidic Paleustalfs | Alfisols. |

In winter, Floyd County receives approximately 67 percent of the total possible sunshine; in summer, it receives about 78 percent. Average annual free water (lake) evaporation is estimated at 69 inches.

The Polar Canadian airmasses that sweep southward across the Great Plains in winter bring sharp drops in temperature in the Floydada area. Sometimes temperature changes are accompanied by strong, northerly winds. However, cold spells rarely last for more than 48 hours before sunshine and southwesterly winds bring rapid warming. Nights are mostly clear and cold with freezes almost every night, while most days are sunny and mild. The lowest temperature on record in Floyd County (since 1953) is –9° F, which occurred on January 13, 1963. Winter is dry. Precipitation most often falls in the form of light snow, which piles up in drifts, so that the snowmelt is not uniformly distributed.

Spring offers the greatest variety in weather. Warm and cold spells follow each other in rapid succession throughout March and April. Trees and shrubs may bloom too early and be nipped by a late freeze. March and April are the windiest months of the year. Occasionally, persistently strong southwesterly to northwesterly winds cause blowing dust in the area. Thunderstorms, which rarely occur in winter, increase in number and reach a peak of intensity in May and June. In an average year, May and June are the wettest months.

Summer is pleasant. Afternoon temperatures are sometimes hot, but most nights are pleasantly cool. Cloudiness or precipitation during the day causes a significant drop in temperature. Evaporative-type air-conditioners operate efficiently in this relatively dry climate. The highest temperature on record at Floydada (since 1953) is 109°, which occurred on June 15, 1953.

Fall, like summer, is pleasant. The weather is more varied than in summer, and temperatures are moderate. Days are mild and sunny, and nights are clear and cool. Winds are not so strong as those in spring. Rainfall increases slightly in the early fall, then decreases rather sharply in November.

The average length of the warm season (freeze-free period) in Floyd County is 213 days. The average date of the last occurrence of 32° or below in the spring is April 7, and the first occurrence of 32° or below in the fall is November 6.

## History and Settlement

Floyd County was formed in 1876 from the Bexar District. The county was named for D.W. Floyd, who was killed in the battle of the Alamo.

Plains Indians were about the only inhabitants of the county until buffalo hunters arrived in the 1860's. Ranchers soon followed. About the beginning of this century, most of the land had been settled and was in cultivation. In 1910, the first railroad came into the county and helped speed the development of the county.

Irrigation became significant in the 1930's and reached a peak in the mid 1950's. Since then, it has slowly declined because the water table is being lowered by the removal of water for irrigation. Every year a few wells have to be abandoned. However, irrigation has made Floyd County one of the leading Texas counties in crop income.

In the 1970 census, Floyd County had a population of 11,044, a decline from the 1960 population of 12,369.

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## *Glossary*

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

**Association, soil.** A group of soils geographically associated in a characteristic repeating pattern.

**Available water capacity** (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

**Calcareous soil.** A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

**Caliche.** A more or less cemented deposit of calcium carbonate in many soils of warm-temperature areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

**Chiseling.** Tillage of soil with an implement having one or more soil penetrating points that loosen the subsoil and brings *clods* to the surface. A form of emerging tillage to control soil blowing.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

**Claypan.** A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

**Colluvium.** Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

TABLE 8.—*Temperature*

[Data from Floydada; 1953–69;

| Month | Temperature [1] | | | | Precipitation | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Probability of receiving— | | |
| | Average high | Average monthly highest | Average low | Average monthly lowest | Average total [1] | 0 or trace | 0.50 inch or more | 1 inch or more |
| | °F | °F | °F | °F | In | Pct | Pct | Pct |
| January | 53.4 | 73.9 | 23.1 | 4.0 | 0.41 | 4 | 49 | 27 |
| February | 57.3 | 77.1 | 26.5 | 9.6 | 0.64 | 10 | 50 | 24 |
| March | 65.5 | 83.8 | 32.8 | 14.4 | 0.77 | 11 | 55 | 30 |
| April | 76.2 | 91.8 | 44.3 | 28.7 | 1.16 | ([3]) | 75 | 52 |
| May | 83.3 | 96.5 | 53.7 | 40.3 | 2.84 | ([3]) | 96 | 90 |
| June | 90.1 | 101.0 | 62.7 | 52.6 | 3.35 | ([3]) | 85 | 75 |
| July | 93.2 | 100.3 | 66.8 | 59.6 | 2.68 | ([3]) | 80 | 69 |
| August | 92.3 | 100.1 | 64.5 | 56.5 | 1.62 | 3 | 78 | 60 |
| September | 85.7 | 95.9 | 57.6 | 45.0 | 1.93 | 4 | 76 | 60 |
| October | 73.7 | 91.0 | 46.5 | 32.9 | 2.13 | 5 | 80 | 80 |
| November | 64.0 | 81.1 | 34.0 | 18.7 | 0.65 | 18 | 40 | 22 |
| December | 55.6 | 74.5 | 26.8 | 11.8 | 0.57 | 10 | 50 | 30 |
| Year | 74.2 | | 44.9 | | 18.75 | | | |

[1] Average length of record, 17 years.
[2] Average length of record, 14 years.
[3] Less than 1 percent.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard and brittle; little affected by moistening.

**Contour farming.** Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

**Cutbanks cave.** Walls of cuts not stable.

**Drainage class** (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

*Excessively drained* soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

*Somewhat excessively drained* soils are also very permeable and are free from mottling throughout their profile.

*Well-drained* soils are nearly free from mottling and are commonly of intermediate texture.

*Moderately well drained* soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

*Somewhat poorly drained* soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

*Poorly drained* soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

*Very poorly drained* soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

**Deferred grazing.** The practice of delaying grazing until range plants have reached a definite stage of growth, in order to increase the vigor of the forage and to allow the desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

**Diversion, or diversion terrace.** A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

**Eolian soil material.** Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

**Erosion.** The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

**Excess lime.** Carbonates restrict plant growth.

**Fallow.** Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

**Fertility, soil.** The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

*and precipitation*

elevation 3,180 feet]

| Precipitation—Continued | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Probability of receiving—Continued | | | | | Average number of days with precipitation of—[2] | | | Snow and sleet | | |
| 2 inches or more | 3 inches or more | 4 inches or more | 5 inches or more | 6 inches or more | 0.10 inch or more | 0.50 inch or more | 1 inch or more | Average total [1] | Maximum monthly [1] | Greatest depth [2] |
| *Pct* | *Pct* | *Pct* | *Pct* | *Pct* | | | | *In* | *In* | *In* |
| 7 | 2 | (3) | (3) | (3) | 1 | (4) | 0 | 1.5 | 7.0 | ---- |
| 5 | 2 | (3) | (3) | (3) | 2 | (4) | 0 | 3.3 | 13.0 | 12 |
| 9 | 3 | 2 | (3) | (3) | 2 | 1 | 0 | 1.8 | 11.0 | 6 |
| 23 | 10 | 5 | 2 | (3) | 2 | 1 | (4) | (5) | (5) | (5) |
| 70 | 50 | 34 | 23 | 15 | 5 | 1 | (4) | (5) | (5) | 0 |
| 54 | 35 | 22 | 13 | 10 | 5 | 3 | 1 | 0 | 0 | 0 |
| 41 | 20 | 10 | 5 | 1 | 4 | 2 | 1 | 0 | 0 | 0 |
| 39 | 20 | 10 | 5 | 5 | 3 | 1 | 1 | 0 | 0 | 0 |
| 36 | 23 | 14 | 10 | 6 | 4 | 2 | 1 | 0 | 0 | 0 |
| 39 | 24 | 14 | 8 | 4 | 3 | 1 | 1 | 0 | 0 | 0 |
| 8 | 3 | 1 | (3) | (3) | 2 | (4) | (4) | 0.4 | 4.0 | 3 |
| 10 | 4 | 2 | (3) | (3) | 2 | (4) | (4) | 1.1 | 10.5 | 10 |
| ---------- | ---------- | ---------- | ---------- | ---------- | 35 | 12 | 5 | 8.1 | 13.0 | 12 |

[4] Less than one-half day.
[5] Trace.

**Flood plain.** Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

**Gilgai.** Typically, the microrelief of Vertisols—clayey soils that have a high coefficient of expansion and contraction with changes in moisture; usually a succession of microbasins and microknolls, in nearly level areas, or of microvalleys and microridges that run with the slope.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains. The distinction between gully and rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. V-shaped gullies result if the material is more difficult to erode with depth; whereas U-shaped gullies result if the lower material is more easily eroded than that above it.

**Hardpan.** A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

*A horizon.*—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

*B horizon.*—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon the A horizon alone is the solum.

*C horizon.*—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

*R layer.*—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

**Humus.** The well-decomposed, more or less stable part of the organic matter in mineral soils.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are—

*Border.*—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

*Basin.*—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

*Controlled flooding.*—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

*Corrugation.*—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

*Furrow.*—Water is applied in small ditches made by cultivation implements used for tree and row crops.

*Sprinkler.*—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

*Subirrigation.*—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

*Wild flooding.*—Irrigation water, released at high points, flows onto the field without controlled distribution.

**Loess.** Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

**Low strength.** Inadequate strength to support the load.

**Mohs scale of hardness.** Empirical scale for determining the relative hardness of a mineral. Each mineral tested is rated by comparison to ten standard minerals. The standard minerals and their hardness numbers are as follows: talc (1); gypsum (2); calcite (3); fluorite (4); apatite (5); orthoclase (6); quartz (7); topaz (8); corundum (9); and diamond (10).

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineralogical, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

the three simple variables—hue, value, and chroma. For

**Munsell notation.** A system for designating color by degrees of

example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

**Parent material.** Disintegrated and partly weathered rock from which soil has formed.

**Ped.** An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

**Percs slowly.** Water moves through the soil too slowly.

**Permeability.** The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

**Phase, soil.** A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

**pH value.** A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

**Piping.** Water can form tunnels or pipelike cavities in the soil.

**Plowpan.** A compacted layer formed in the soil immediately below the plowed layer.

**Poorly graded.** A soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles in poorly graded soil material, density can be increased only slightly by compaction.

**Profile, soil.** A vertical section of the soil through all its horizons and extending into the parent material.

**Reaction, soil.** The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

| | pH | | pH |
|---|---|---|---|
| Extremely acid | Below 4.5 | Neutral | 6.6 to 7.3 |
| Very strongly acid | 4.5 to 5.0 | Mildly alkaline | 7.4 to 7.8 |
| Strongly acid | 5.1 to 5.5 | Moderately alkaline | 7.9 to 8.4 |
| Medium acid | 5.6 to 6.0 | Strongly alkaline | 8.5 to 9.0 |
| Slightly acid | 6.1 to 6.5 | Very strongly alkaline | 9.1 and higher |

**Regolith.** The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Only the upper part of this, modified by organisms and other soil-building forces, is regarded by soil scientists as soil. Most American engineers speak of the whole regolith, even to great depths, as "soil."

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Rill.** A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

**Rooting depth.** Soil thin over layer that restricts roots.

**Sand.** Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

**Seepage.** Water moves through soil too fast.

**Silt.** Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

**Slickensides.** Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on relatively steep slopes and in swelling clays, where there is marked change in moisture content.

**Soil.** A natural, three dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeters); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

**Solum.** The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

**Structure, soil.** The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Surface soil.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Tilth, soil.** The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

**Topsoil.** A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

**Trace elements.** The chemical elements found in soils in extremely small amounts, yet which are essential to plant growth. Some of the trace elements are zinc, cobalt, manganese, copper, and iron.

**Unstable fill.** Banks of fills likely to cave or slough.

**Water table.** The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

**Well-graded soil.** A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

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GUIDE TO MAPPING UNITS

For complete information about a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit, a range site, wildlife rating, or recreational development, read the introduction to the section it is in for general information about its management. Dashes in a column mean that the mapping unit was not placed in that particular grouping.

| Map symbol | Mapping unit | Page | Capability unit | | Range site | |
|---|---|---|---|---|---|---|
| | | | Dryland | Irrigated | Name | Page |
| AfA | Amarillo fine sandy loam, 0 to 1 percent slopes | 6 | IIIe-3 | IIe-2 | Sandy Loam | 42 |
| AfB | Amarillo fine sandy loam, 1 to 3 percent slopes | 7 | IIIe-3 | IIIe-3 | Sandy Loam | 42 |
| AfC | Amarillo fine sandy loam, 3 to 5 percent slopes | 7 | IVe-2 | IVe-1 | Sandy Loam | 42 |
| BeB | Berda loam, 1 to 3 percent slopes | 8 | IIIe-2 | IIIe-2 | Hardland Slopes | 41 |
| BeC | Berda loam, 3 to 5 percent slopes | 8 | IVe-3 | IVe-2 | Hardland Slopes | 41 |
| BeD | Berda loam, 5 to 12 percent slopes | 9 | VIe-2 | ------ | Hardland Slopes | 41 |
| BoE | Berda and Paloduro soils, 5 to 20 percent slopes | 9 | VIe-2 | ------ | Hardland Slopes | 41 |
| BPG | Berda and Potter soils, steep | 9 | VIIe-1 | ------ | Rough Breaks | 42 |
| BtA | Bippus clay loam, 0 to 1 percent slopes | 11 | IIe-1 | IIe-1 | Valley | 43 |
| Bw | Bippus clay loam, frequently flooded | 11 | Vw-1 | ------ | Valley | 43 |
| DrB | Drake soils, 1 to 3 percent slopes | 12 | IVe-5 | IIIe-5 | High Lime | 41 |
| DrC | Drake soils, 3 to 5 percent slopes | 12 | VIe-3 | IIIe-5 | High Lime | 41 |
| EsA | Estacado clay loam, 0 to 1 percent slopes | 13 | IIIe-5 | IIe-1 | Hardland Slopes | 41 |
| EsB | Estacado clay loam, 1 to 3 percent slopes | 13 | IIIe-2 | IIIe-2 | Hardland Slopes | 41 |
| FoB | Flomot fine sandy loam, 1 to 3 percent slopes | 14 | IVe-1 | IIIe-4 | Mixedland Slopes | 41 |
| FoC | Flomot fine sandy loam, 3 to 5 percent slopes | 15 | IVe-3 | IVe-2 | Mixedland Slopes | 41 |
| FoD | Flomot fine sandy loam, 5 to 12 percent slopes | 15 | VIe-2 | ------ | Mixedland Slopes | 41 |
| LaE | Latom soils and Rock outcrop, 5 to 20 percent slopes | 15 | VIIs-1 | ------ | Very Shallow | 43 |
| LkD | Likes loamy fine sand, 3 to 8 percent slopes | 17 | VIe-1 | ------ | Sandy | 42 |
| Ln | Lincoln soils, frequently flooded | 17 | Vw-2 | ------ | Sandy Bottomland | 42 |
| Lo | Lofton clay loam | 19 | IIIe-4 | IIs-1 | Clay Loam | 40 |
| MaB | Mansker clay loam, 1 to 3 percent slopes | 20 | IVe-1 | IIIe-4 | Hardland Slopes | 41 |
| MaC | Mansker clay loam, 3 to 5 percent slopes | 20 | IVe-3 | IVe-2 | Hardland Slopes | 41 |
| MoB | Mobeetie fine sandy loam, 0 to 3 percent slopes | 21 | IVe-4 | IIIe-3 | Mixedland Slopes | 41 |
| ObD | Obaro and Quinlan soils, 5 to 12 percent slopes | 21 | VIe-3 | ------ | Mixedland | 41 |
| OtA | Olton clay loam, 0 to 1 percent slopes | 23 | IIIe-5 | IIe-1 | Clay Loam | 40 |
| OtB | Olton clay loam, 1 to 3 percent slopes | 23 | IIIe-2 | IIIe-2 | Clay Loam | 40 |
| PaA | Paloduro loam, 0 to 1 percent slopes | 24 | IIIe-3 | IIe-2 | Hardland Slopes | 41 |
| PdG | Polar and Paloduro soils, 3 to 30 percent slopes | 25 | VIs-1 | ------ | Gravelly | 40 |
| PmA | Portales loam, 0 to 1 percent slopes | 26 | IIIe-5 | IIe-2 | Hardland Slopes | 41 |
| PsD | Posey and Tulia soils, 5 to 12 percent slopes | 27 | VIe-2 | ------ | Hardland Slopes | 41 |
| PtE | Potter soils, 2 to 20 percent slopes | 28 | VIIs-1 | ------ | Very Shallow | 43 |
| PuA | Pullman clay loam, 0 to 1 percent slopes | 30 | IIIe-4 | IIs-1 | Clay Loam | 40 |
| PuB | Pullman clay loam, 1 to 3 percent slopes | 30 | IIIe-1 | IIIe-1 | Clay Loam | 40 |
| Ra | Randall clay | 32 | ------ | ------ | (1/) | -- |
| | Undrained areas | -- | VIw-1 | ------ | ---------------- | -- |
| | Drained areas | -- | IVs-1 | IVs-1 | ---------------- | -- |
| SpD | Springer loamy fine sand, 3 to 8 percent slopes | 33 | VIe-1 | ------ | Sandy | 42 |

1/ Areas of Randall clay are in the same range site as that of the adjacent soils.

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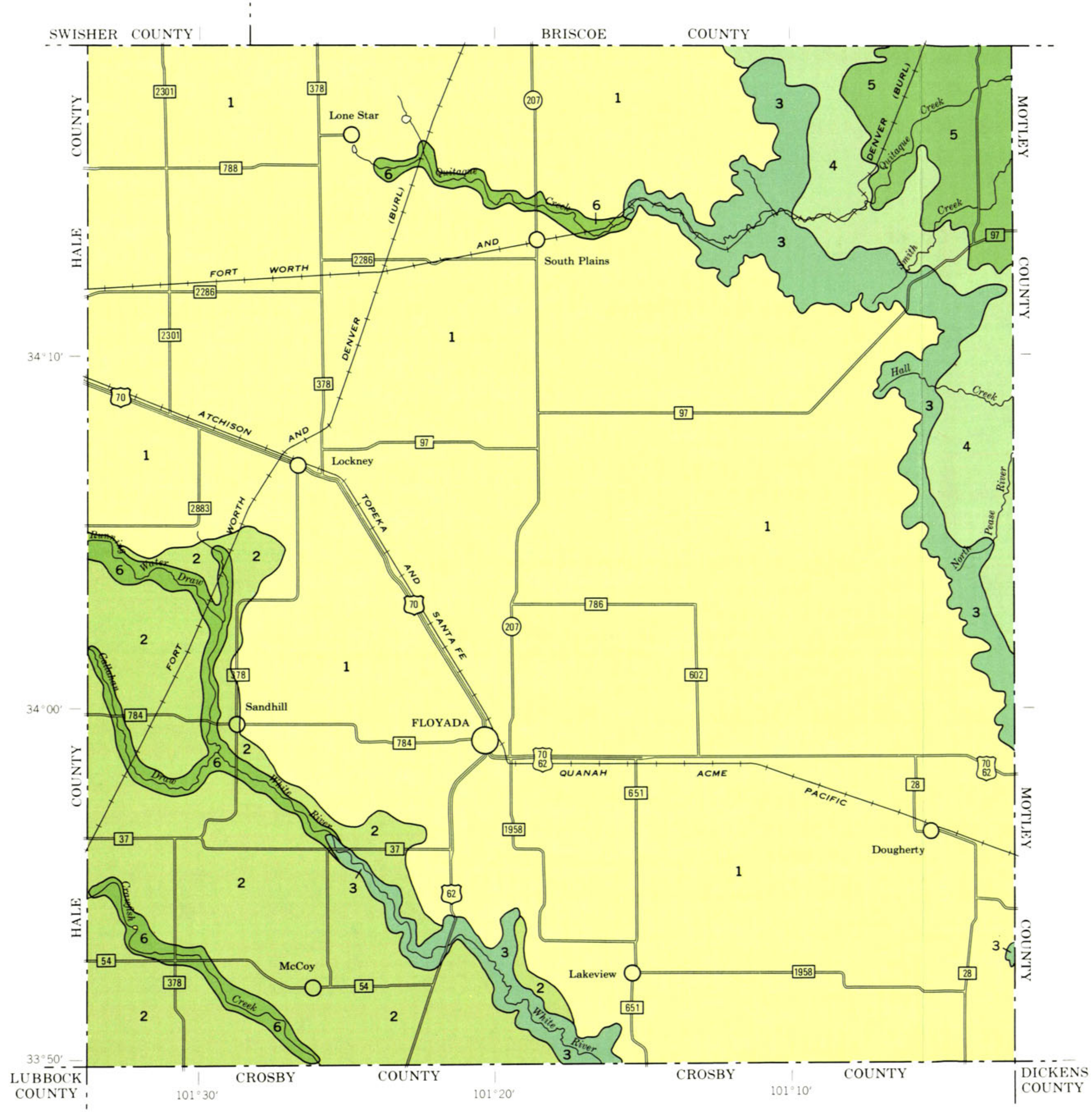



## SOIL ASSOCIATIONS*

| | |
|---|---|
| 1 | Pullman association: Deep, nearly level to gently sloping, very slowly permeable clay loams |
| 2 | Pullman-Olton association: Deep, nearly level to gently sloping, very slowly permeable to moderately slowly permeable clay loams |
| 3 | Berda-Potter association: Deep to very shallow, gently sloping to steep, moderately permeable loams |
| 4 | Latom-Polar association: Very shallow to deep, gently sloping to moderately steep, moderately permeable and moderately rapidly permeable fine sandy loams to gravelly fine sandy loams |
| 5 | Amarillo-Berda association: Deep, nearly level to strongly sloping, moderately permeable fine sandy loams to loams |
| 6 | Mansker-Bippus association: Deep, nearly level to gently sloping, moderately permeable clay loams |

* Texture refers to the surface layer of the major soils

Compiled 1975

N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

# GENERAL SOIL MAP

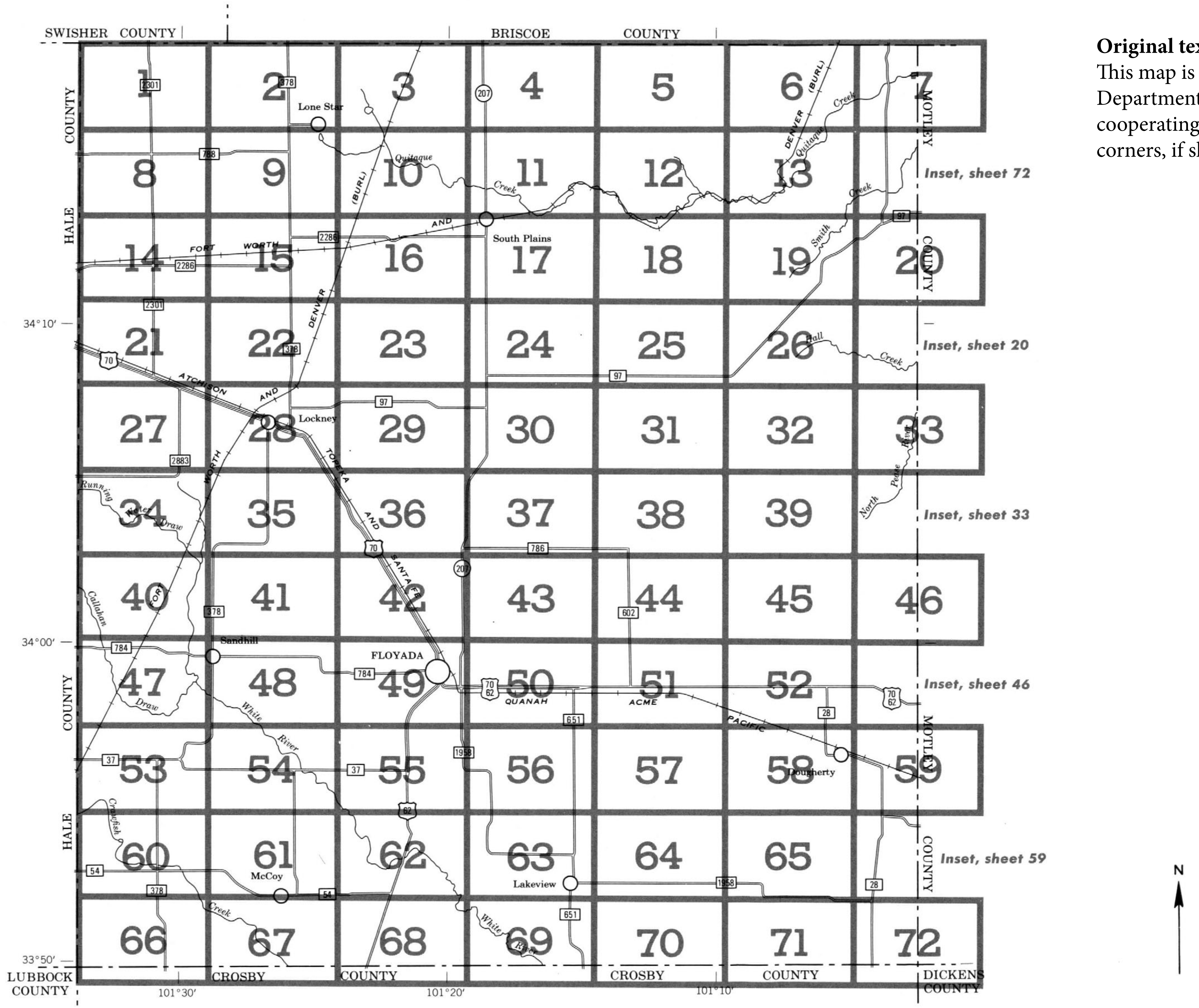
## FLOYD COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

***Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.***

**Original text from each individual map sheet read:**
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.




**INDEX TO MAP SHEETS**

FLOYD COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

## SOIL LEGEND

The first letter, always a capital, is the initial letter of the soil name. The second letter is a capital if the mapping unit is broadly defined 1/; otherwise, it is a small letter. The third letter, always capital, shows the slope. Symbols without slope letters are those of nearly level soils.

1/ The composition of these units is more variable than that of others in the survey area but has been controlled well enough to be interpreted for the expected use of the soils. The symbol (W) following the soil name indicates that signs of erosion, especially of locally shifting of soil by wind, are evident in places, but the degree of erosion cannot be reliably estimated.

| SYMBOL | NAME |
|---|---|
| AfA | Amarillo fine sandy loam, 0 to 1 percent slopes (W) |
| AfB | Amarillo fine sandy loam, 1 to 3 percent slopes (W) |
| AfC | Amarillo fine sandy loam, 3 to 5 percent slopes (W) |
| BeB | Berda loam, 1 to 3 percent slopes |
| BeC | Berda loam, 3 to 5 percent slopes |
| BeD | Berda loam, 5 to 12 percent slopes |
| BoE | Berda and Paloduro soils, 5 to 20 percent slopes |
| BPG | Berda and Potter soils, steep |
| BtA | Bippus clay loam, 0 to 1 percent slopes |
| Bw | Bippus clay loam, frequently flooded |
| DrB | Drake soils, 1 to 3 percent slopes |
| DrC | Drake soils, 3 to 5 percent slopes |
| EsA | Estacado clay loam, 0 to 1 percent slopes |
| EsB | Estacado clay loam, 1 to 3 percent slopes |
| FoB | Flomot fine sandy loam, 1 to 3 percent slopes |
| FoC | Flomot fine sandy loam, 3 to 5 percent slopes |
| FoD | Flomot fine sandy loam, 5 to 12 percent slopes |
| LaE | Latom soils and Rock outcrop, 5 to 20 percent slopes |
| LkD | Likes loamy fine sand, 3 to 8 percent slopes (W) |
| Ln | Lincoln soils, frequently flooded |
| Lo | Lofton clay loam |
| MaB | Mansker clay loam, 1 to 3 percent slopes |
| MaC | Mansker clay loam, 3 to 5 percent slopes |
| MoB | Mobeetie fine sandy loam, 0 to 3 percent slopes |
| ObD | Obaro and Quinlan soils, 5 to 12 percent slopes |
| OtA | Olton clay loam, 0 to 1 percent slopes |
| OtB | Olton clay loam, 1 to 3 percent slopes |
| PaA | Paloduro loam, 0 to 1 percent slopes |
| PdG | Polar and Paloduro soils, 3 to 30 percent slopes |
| PmA | Portales loam, 0 to 1 percent slopes |
| PsD | Posey and Tulia soils, 5 to 12 percent slopes |
| PtE | Potter soils, 2 to 20 percent slopes |
| PuA | Pullman clay loam, 0 to 1 percent slopes |
| PuB | Pullman clay loam, 1 to 3 percent slopes |
| Ra | Randall clay |
| SpD | Springer loamy fine sand, 3 to 8 percent slopes (W) |

# CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

## CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

## WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

## SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

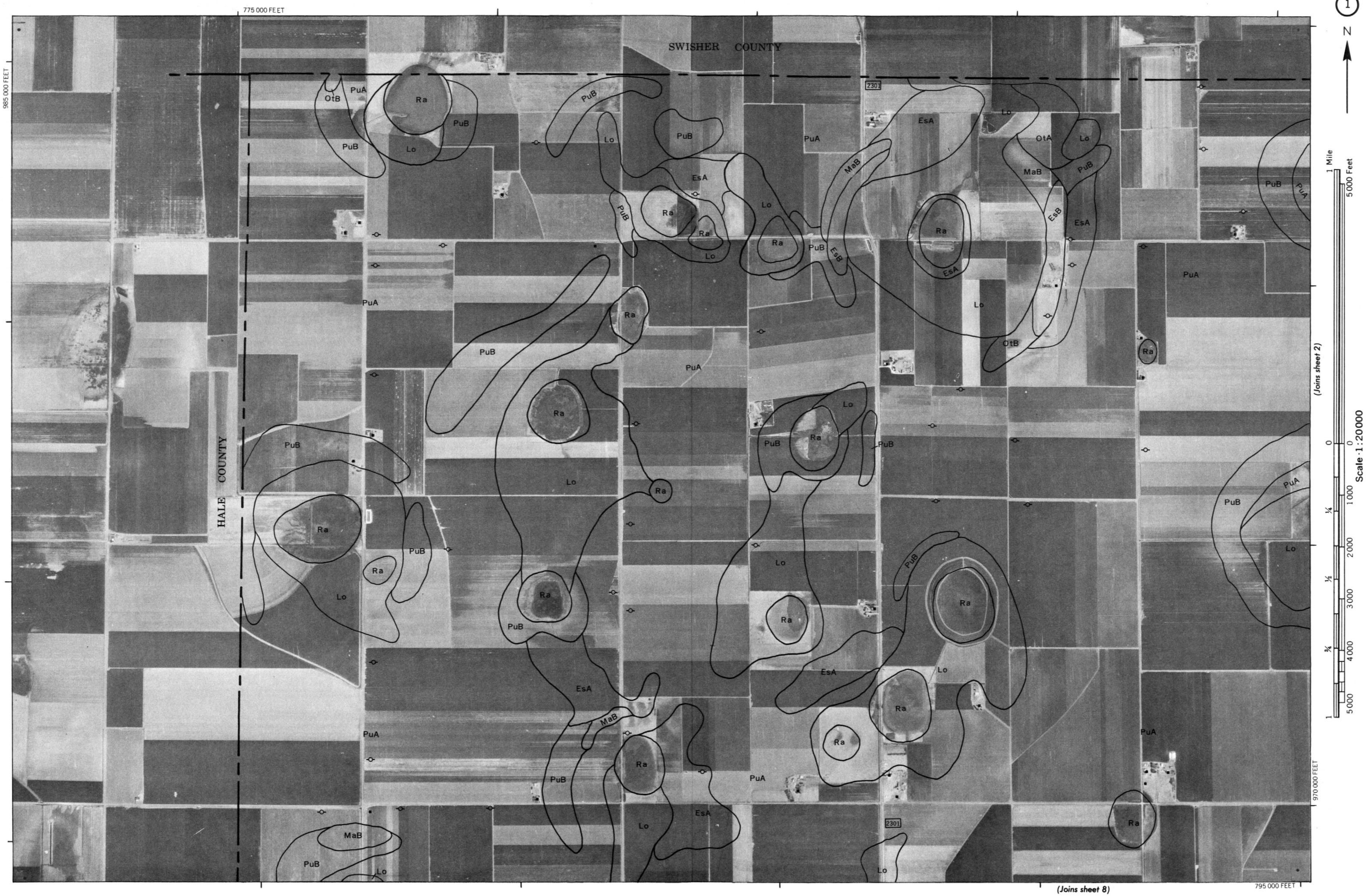
GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

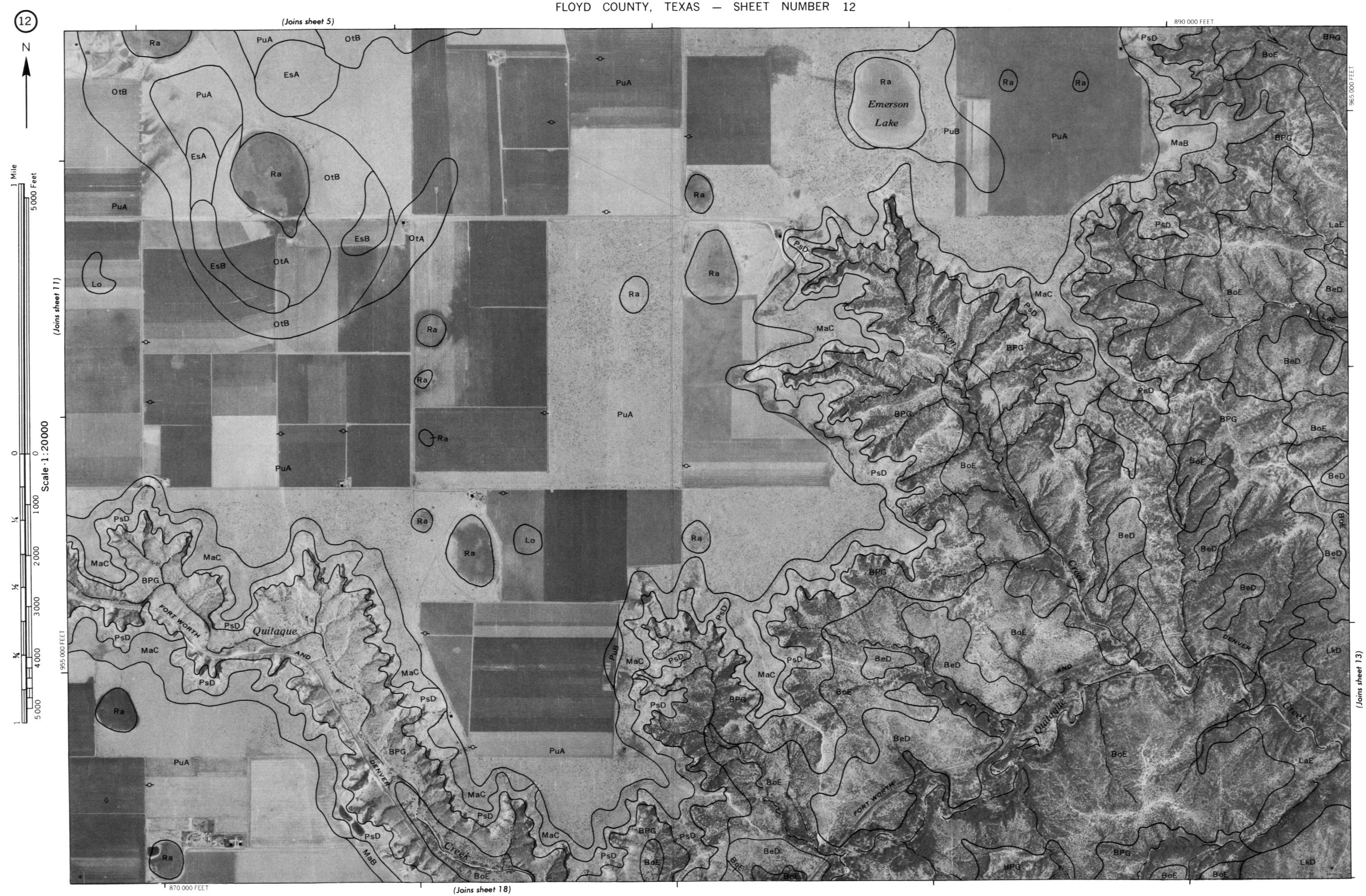
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot


1
N
775 000 FEET
985 000 FEET
970 000 FEET
795 000 FEET
SWISHER COUNTY
HALE COUNTY
2301
(Joins sheet 2)
(Joins sheet 8)
1 Mile
5000 Feet
Scale 1:20000
OtB
PuA
PuB
Ra
Lo
EsA
EsB
MaB
OtA

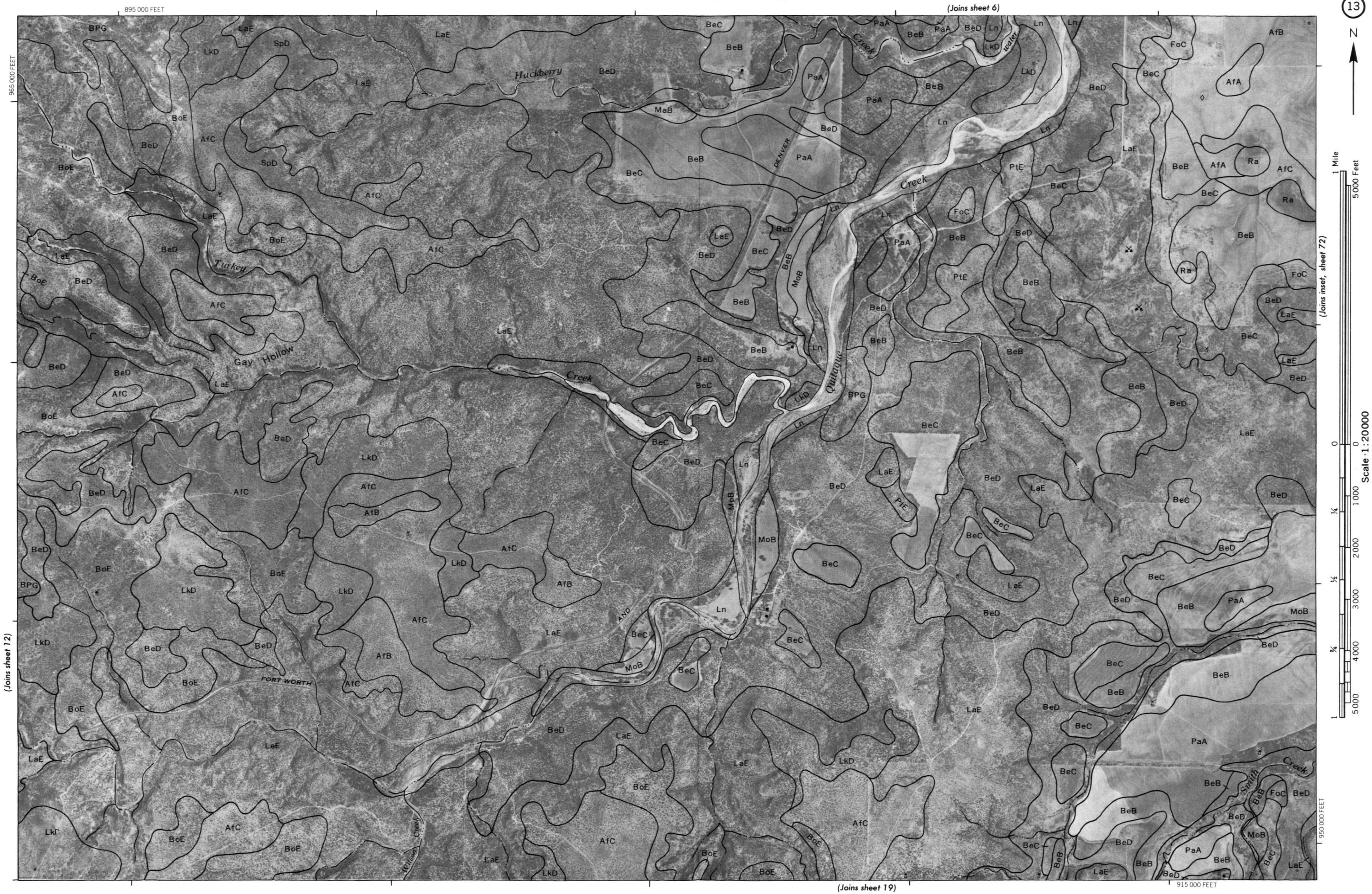
10


(Joins sheet 3)
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 16)
840 000 FEET
965 000 FEET
955 000 FEET
820 000 FEET
N
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
1
Scale 1:20000
Quitaque
Creek
FORT WORTH
AND
DENVER
PuA
PuB
Ra
Lo
MaB
MaC
EsB
EsA


845 000 FEET
(Joins sheet 4)
955 000 FEET
(Joins sheet 12)
(Joins sheet 10)
(Joins sheet 17)
865 000 FEET
955 000 FEET
N
1 Mile
5000 Feet
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
Scale 1:20000
207
207
Quitaque
Creek
DENVER
AND
FORT WORTH
South
Plains
PuB
MaC
MaB
EsB
Ra
Lo
PuA
OtB
OtA
EsA
EsA
PsD
BPG
MaC
MaB
PsD
EsB
PuB
Lo
Ra

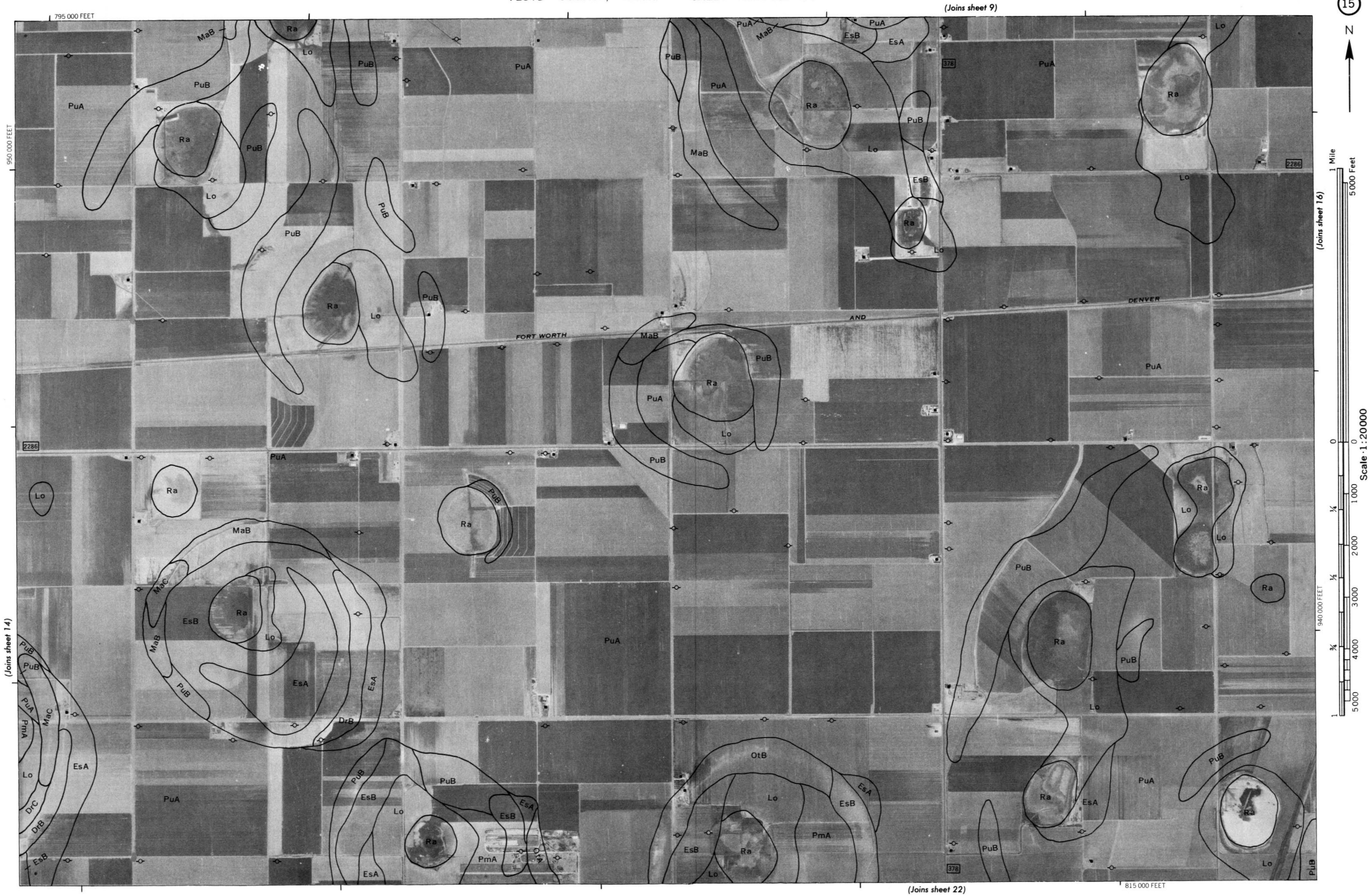

12
N
(Joins sheet 5)
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 18)
890 000 FEET
965 000 FEET
955 000 FEET
870 000 FEET
1 Mile
5000 Feet
Scale 1:20000
Emerson Lake
Emerson Creek
Quitaque Creek
FORT WORTH AND DENVER
Ra
PuA
OtB
EsA
EsB
OtA
Lo
PuB
MaB
PsD
MaC
BPG
BoE
BeD
LaE
LkD

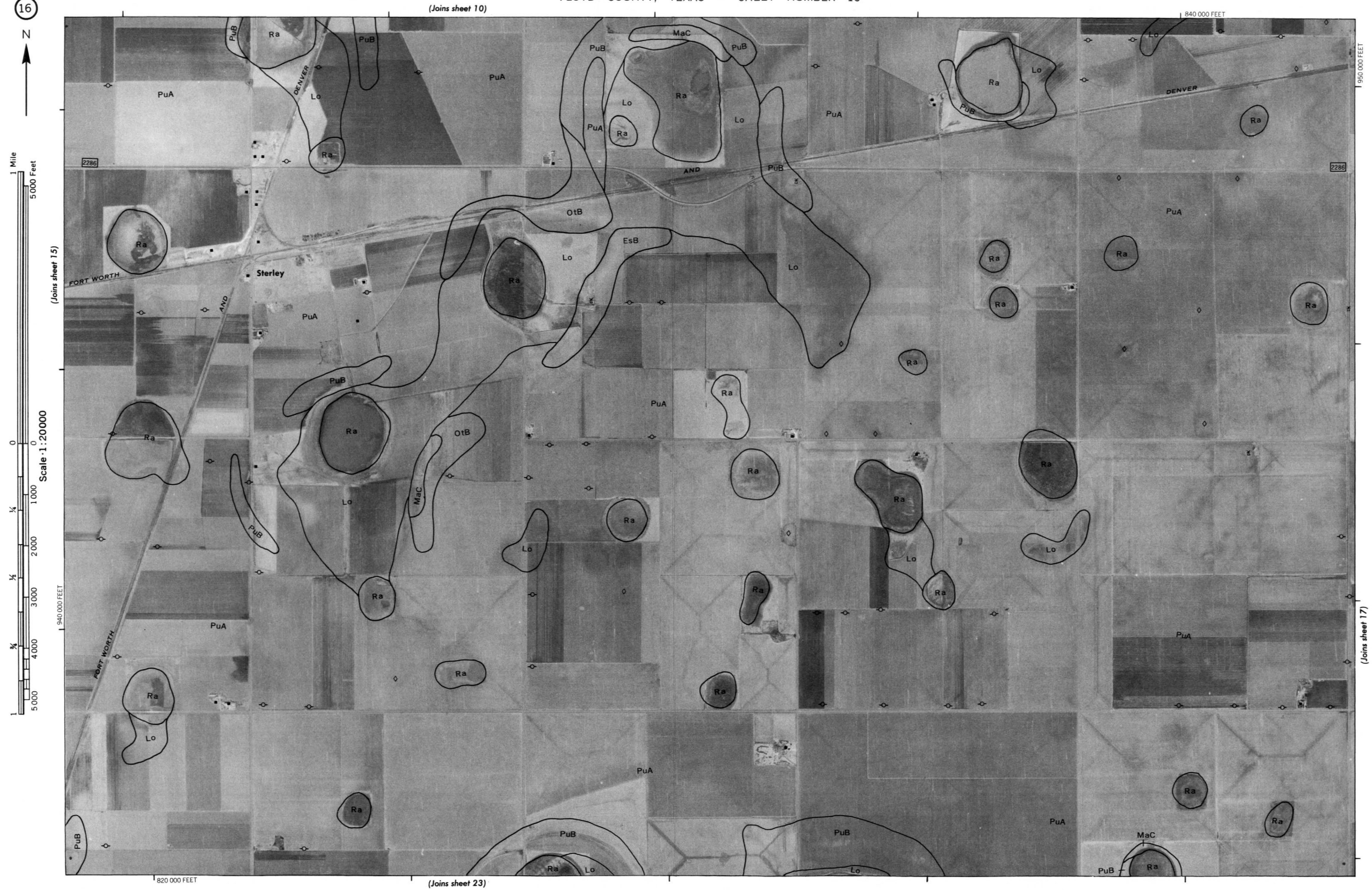
FLOYD COUNTY, TEXAS — SHEET NUMBER 13



FLOYD COUNTY, TEXAS — SHEET NUMBER 14

FLOYD COUNTY, TEXAS — SHEET NUMBER 15

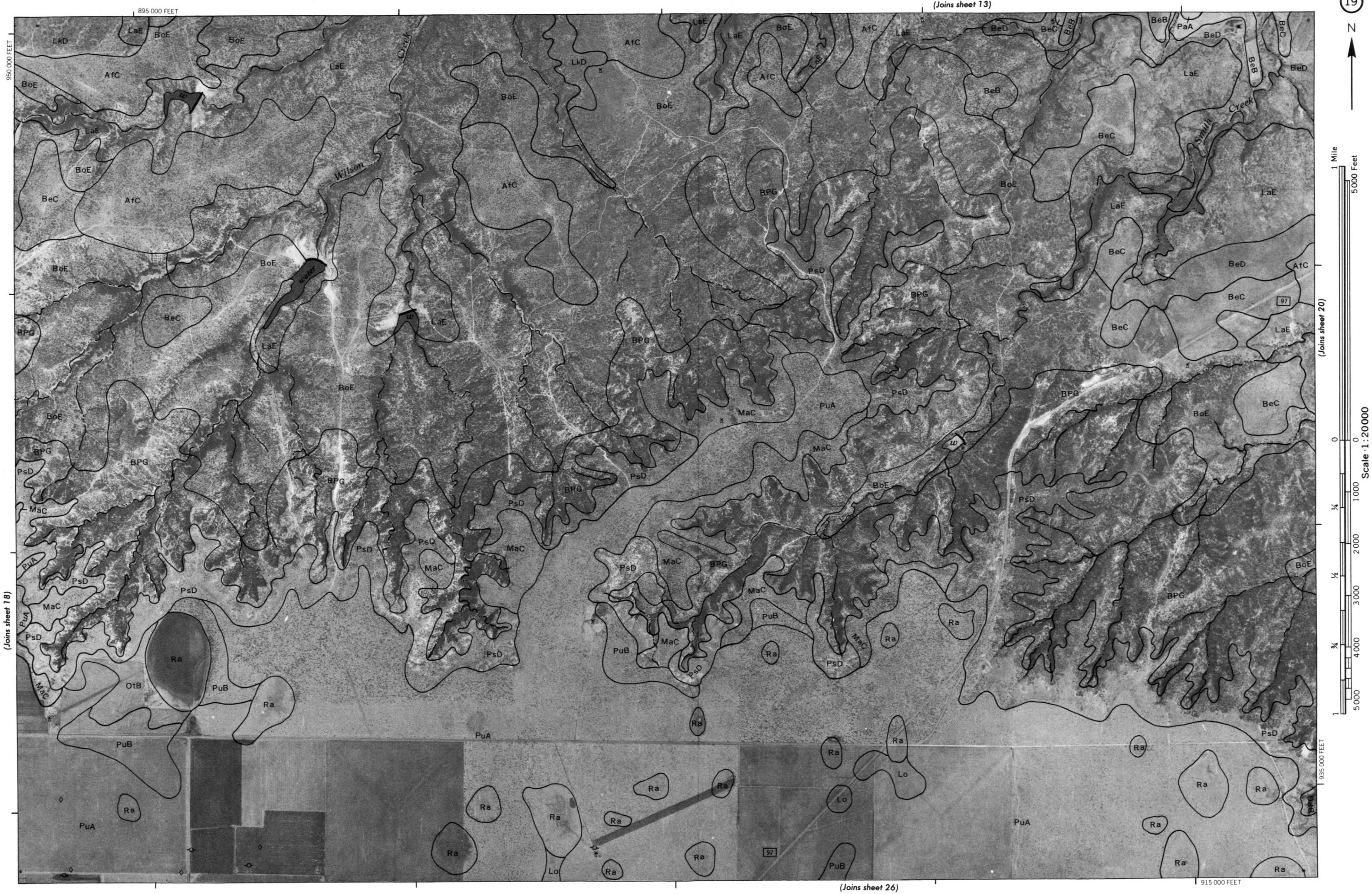



N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
(Joins sheet 10)
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 23)
840 000 FEET
950 000 FEET
940 000 FEET
820 000 FEET
2286
Sterley
FORT WORTH
AND
DENVER
PuA
PuB
Ra
Lo
MaC
OtB
EsB

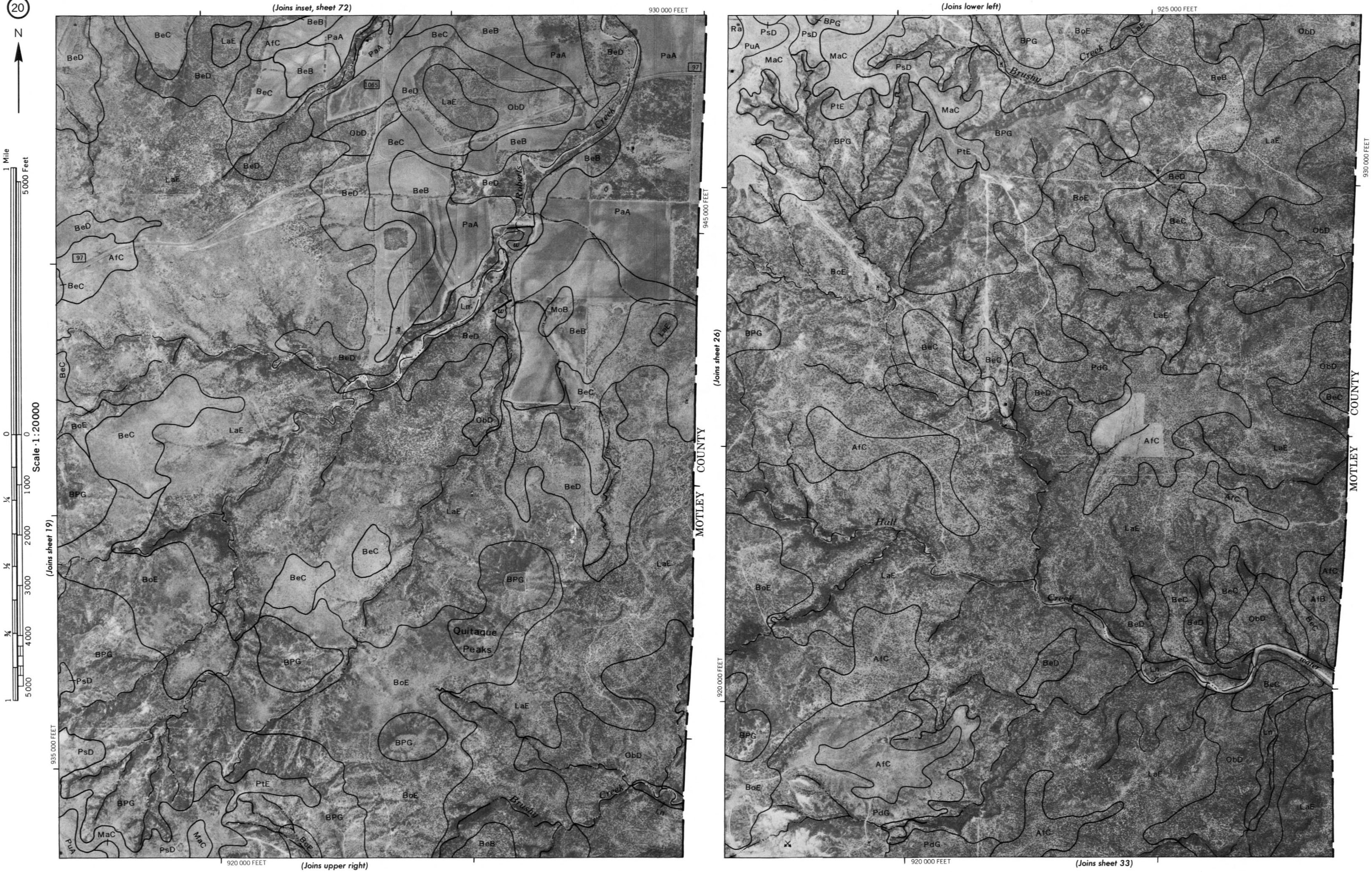
FLOYD COUNTY, TEXAS — SHEET NUMBER 17


(Joins sheet 12)
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 25)
N
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
1000
2000
3000
4000
5000
890 000 FEET
950 000 FEET
870 000 FEET
935 000 FEET
Quitaque
Creek
FORT WORTH
AND
DENVER
Ra
PsD
BoE
BPG
PsD
BPG
BeD
BoE
BoE
LkD
AfC
MaB
PsD
BPG
BeD
BoE
LaE
BeB
BPG
PuA
EsA
BeB
BeD
MaB
MaC
PsD
EsB
MaB
PtE
PuA
MaB
BPG
BoE
MaB
PuA
BeC
MaC
Ra
PsD
MaC
PsD
Ra
PuB
MaB
BPG
Ra
BPG
MaB
PuA
Ra
Lo
PuB
PsD
OtB
MaC
Lo
EsB
MaC
EsA
Ra
BoE
EsA
PuB
Lo
Ra
Ra
Lo
PsD
Ra
MaC
BPG
BPG
Ra
Lo
Ra
PuB
OtB
Ra
Ra
Ra
Ra
PsD
MaB
PuB
PuB
Ra
Ra
Ra
Ra
BPG
Ra
PuA
Ra
MaC
PsD
Ra
Ra
MaB
PsD
MaC
Ra
Ra
Ra
Ra
Ra
Ra
PuA
Ra
Ra
Ra
Ra
MaC
Ra
PuA
OtB
Lo
Ra
Ra
Ra
Ra
Lo
Ra
Ra
Ra
Lo
PuB
Ra
Ra
Ra
Lo
Ra
Ra

FLOYD COUNTY, TEXAS — SHEET NUMBER 19



FLOYD COUNTY, TEXAS — SHEET NUMBER 2


20
N
1 Mile
5000 Feet
Scale 1:20000
(Joins inset, sheet 72)
930 000 FEET
(Joins lower left)
925 000 FEET
930 000 FEET
945 000 FEET
(Joins sheet 26)
MOTLEY COUNTY
(Joins sheet 19)
Roberts Creek
Brushy Creek
Hall Creek
Quitaque Peaks
935 000 FEET
920 000 FEET
(Joins upper right)
920 000 FEET
(Joins sheet 33)


(Joins sheet 14)
770 000 FEET
935 000 FEET
(Joins sheet 22)
(Joins sheet 27)
790 000 FEET
920 000 FEET
21
N
1 Mile
5000 Feet
Scale 1:20000
HALE COUNTY
ATCHISON
TOPEKA
AND
SANTA FE
Aiken
70
2301
PuA
PuB
Ra
Lo
OtA
OtB
EsA
EsB
MaB

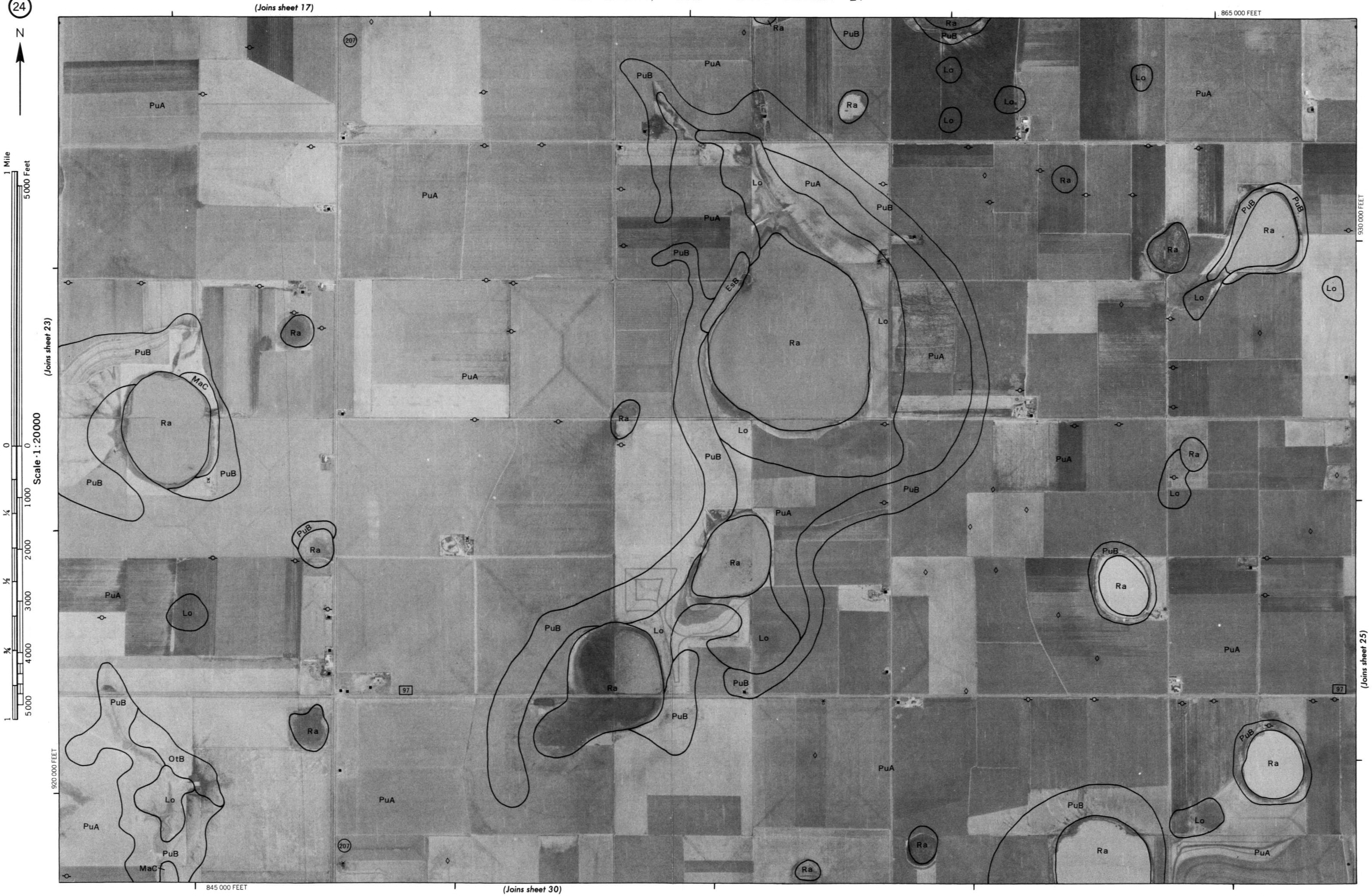

22
N
(Joins sheet 15)
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 28)
815 000 FEET
935 000 FEET
920 000 FEET
795 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
FORT WORTH
AND
DENVER
378
EsA
EsB
Ra
Lo
PuA
PuB
PmA
OtA
OtB
DrB
DrC
MaB
MaC

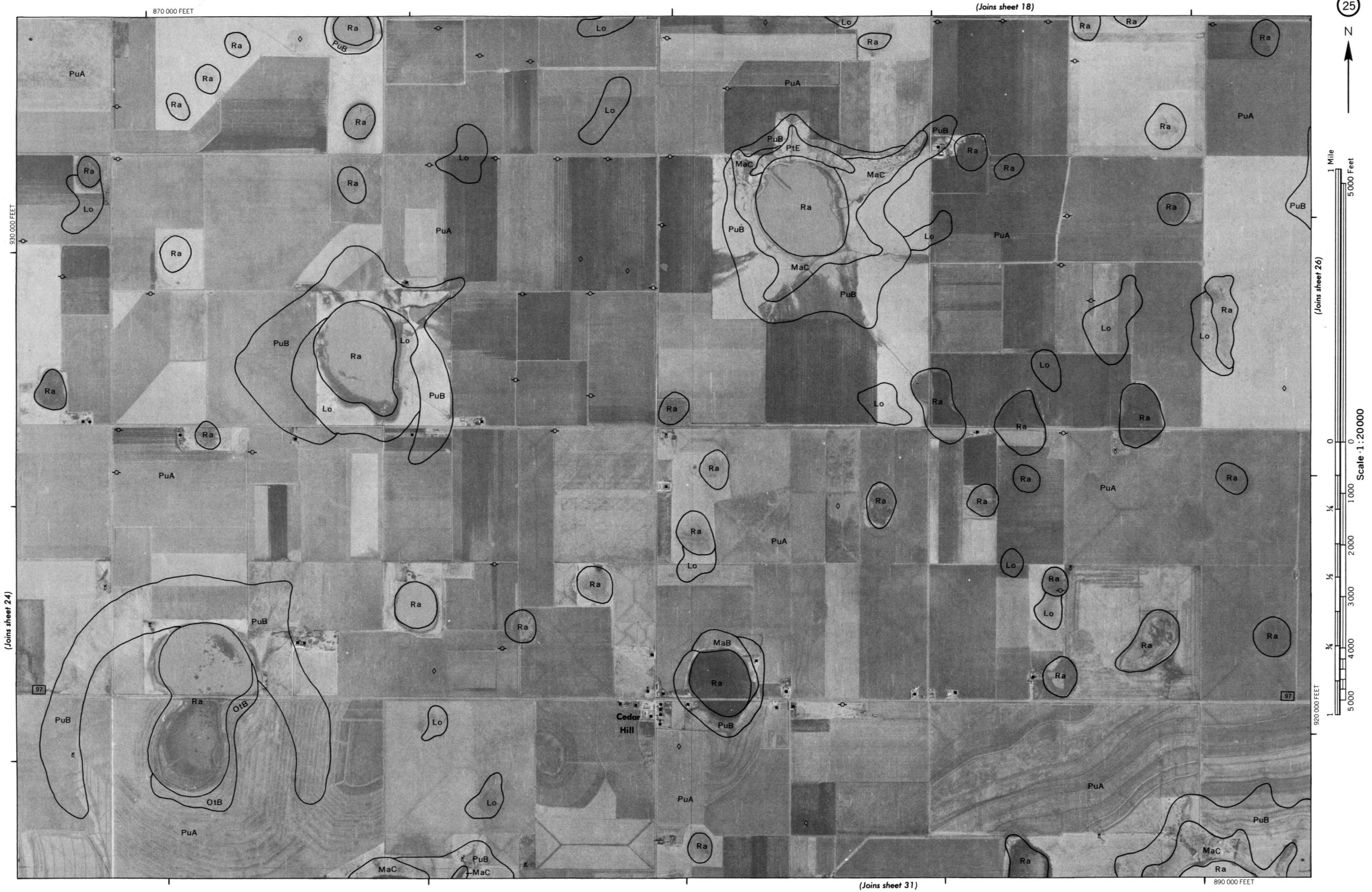
(Joins sheet 16)


(Joins sheet 22)

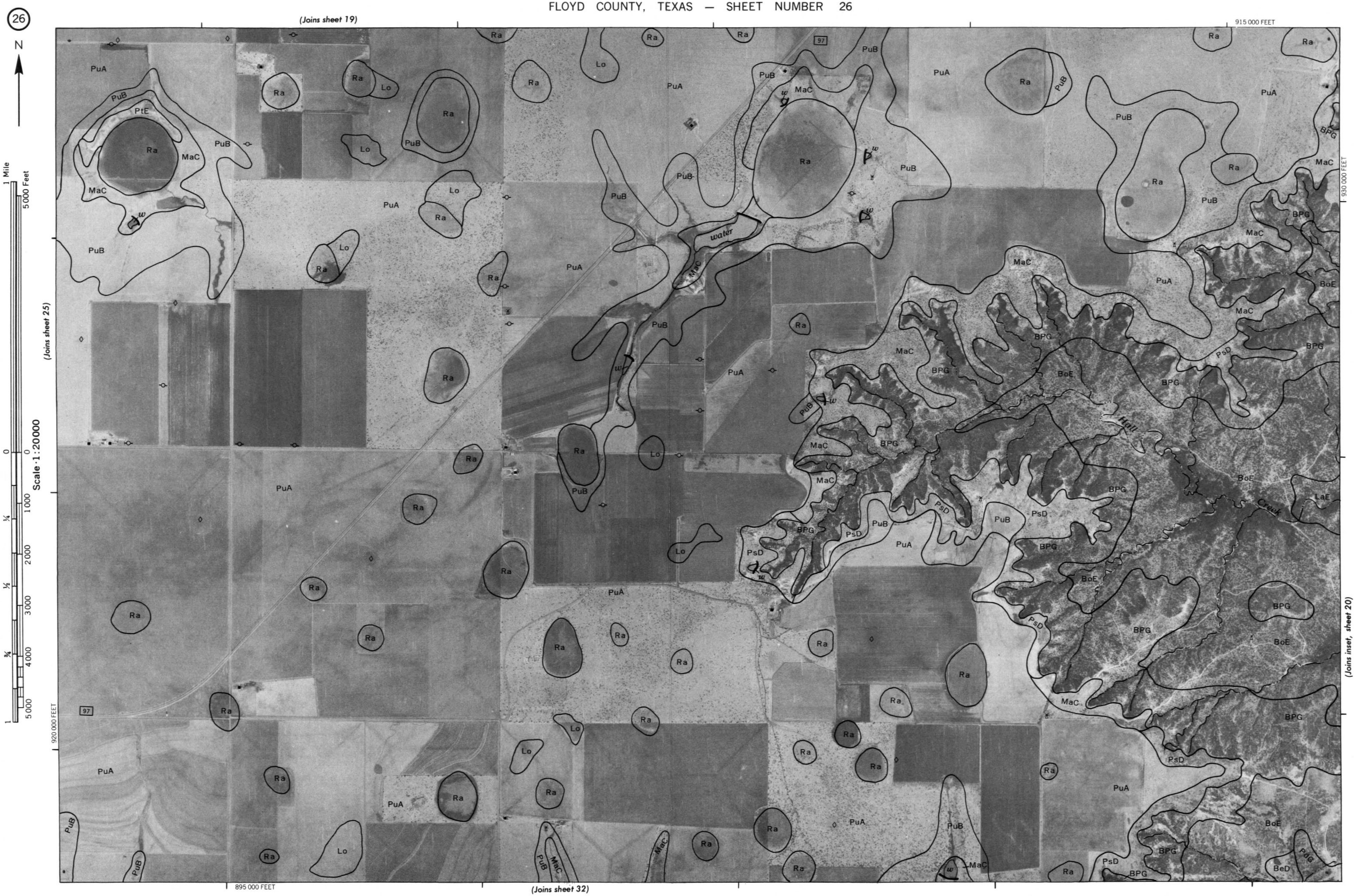
(Joins sheet 24)

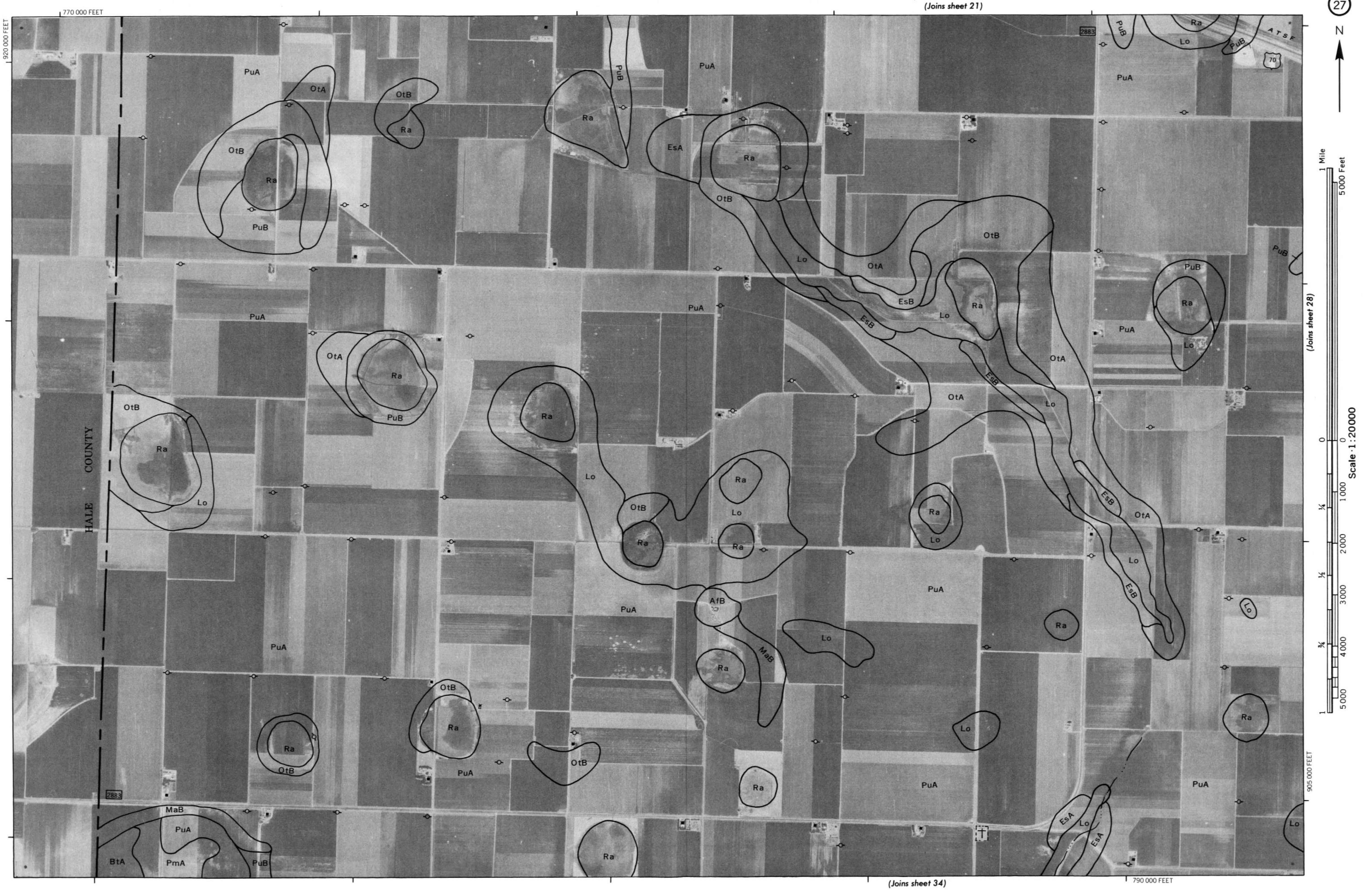
(Joins sheet 29)


N
(Joins sheet 17)
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 30)
865 000 FEET
930 000 FEET
920 000 FEET
845 000 FEET
1 Mile
5 000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
207
97
PuA
PuB
Ra
Lo
MaC
EsB
OtB



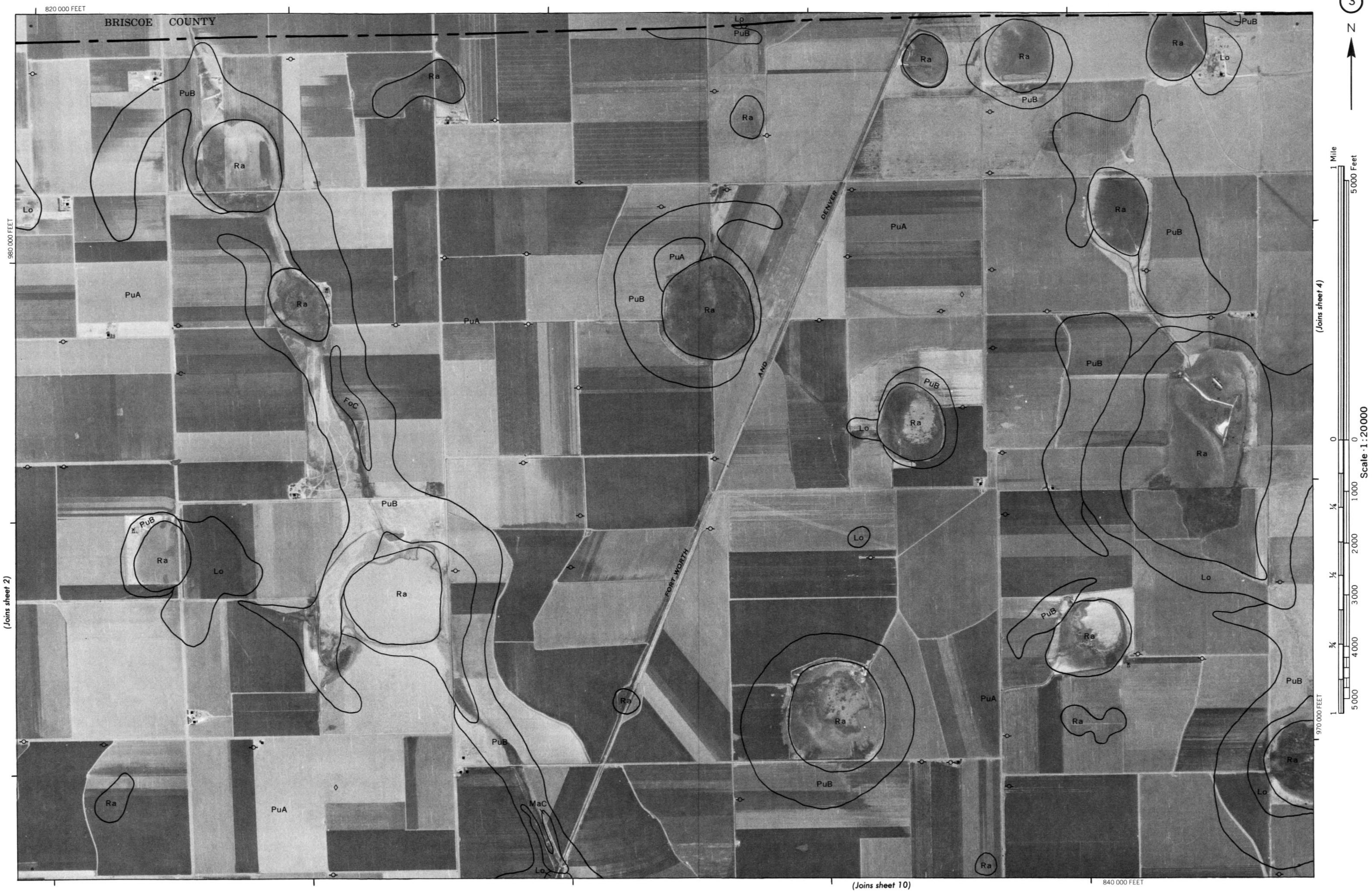
870 000 FEET
(Joins sheet 18)
25
N
930 000 FEET
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 31)
920 000 FEET
890 000 FEET
1 Mile
5000 Feet
Scale 1:20000
Cedar Hill
97
PuA
PuB
Ra
Lo
MaC
PtE
MaB
OtB

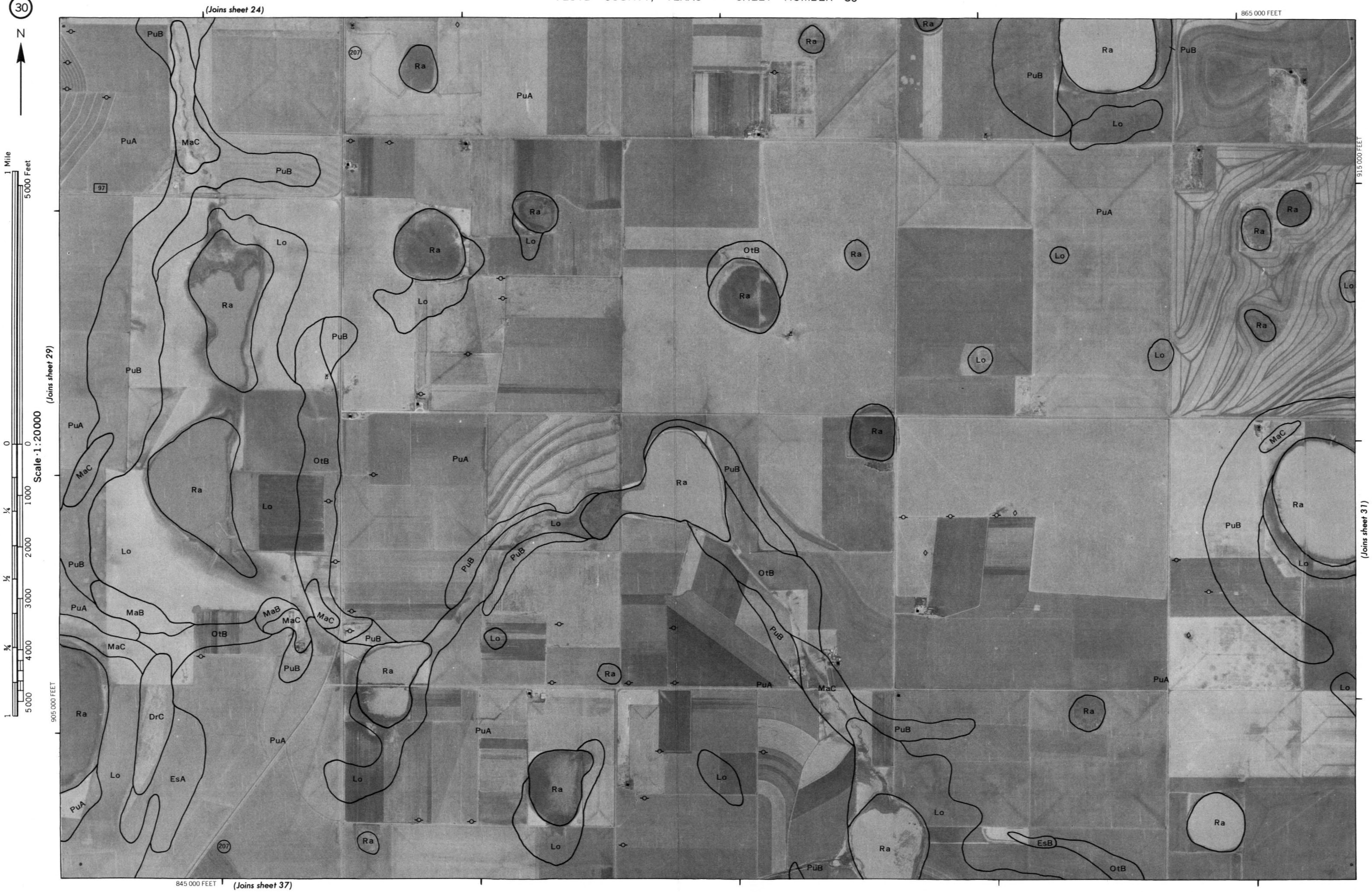

26
N
(Joins sheet 19)
(Joins sheet 25)
(Joins inset, sheet 20)
(Joins sheet 32)
915 000 FEET
930 000 FEET
920 000 FEET
895 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
97
Hall
Creek
water
PuA
PuB
PtE
Ra
MaC
Lo
BPG
BoE
PsD
LaE
BeD
PdG
w

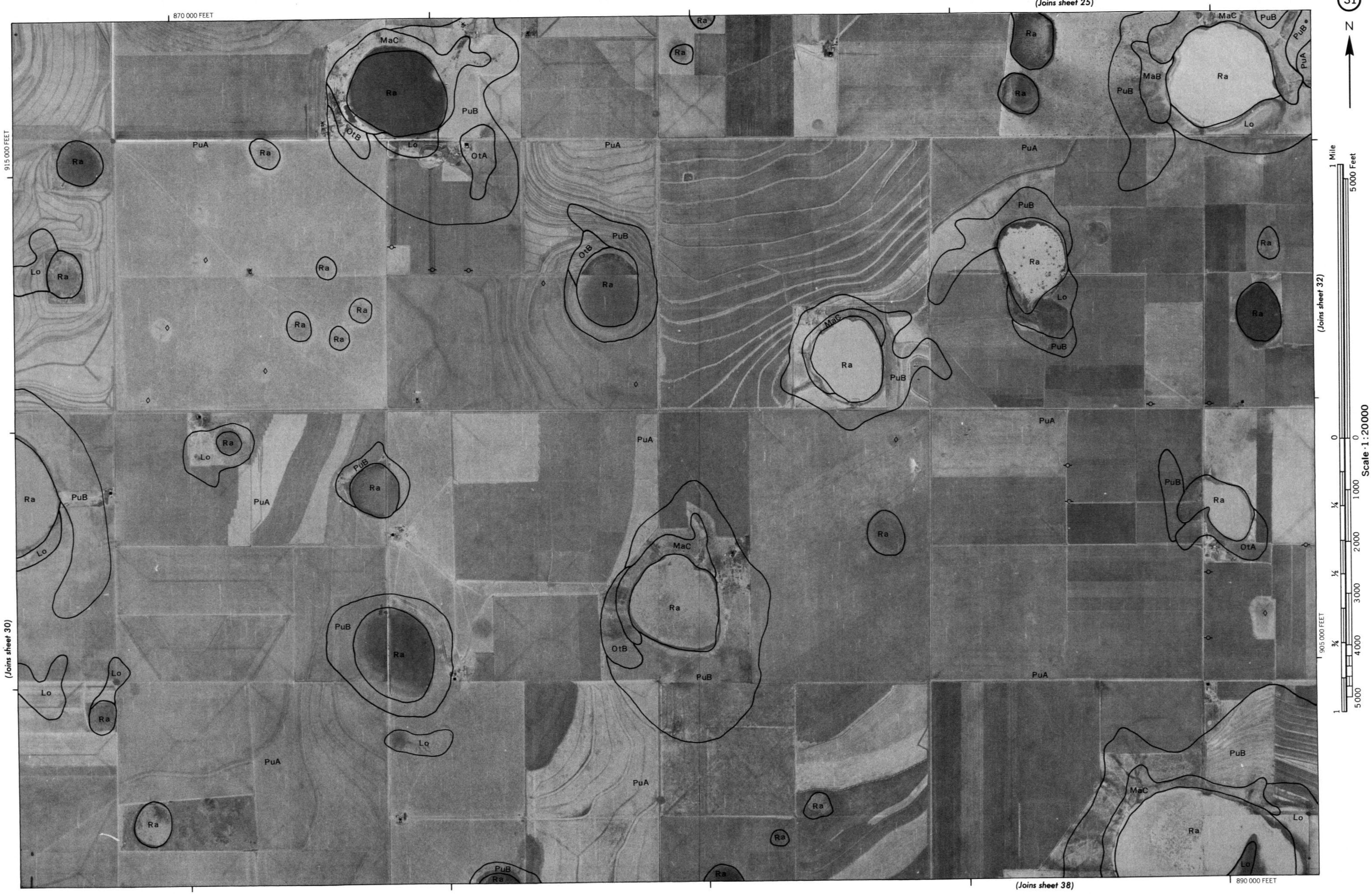

27
N
(Joins sheet 21)
(Joins sheet 28)
(Joins sheet 34)
770 000 FEET
790 000 FEET
920 000 FEET
905 000 FEET
HALE COUNTY
2883
70
A T S F
1 Mile
5000 Feet
Scale 1:20000
PuA
PuB
OtA
OtB
Ra
Lo
EsA
EsB
AfB
MaB
BtA
PmA

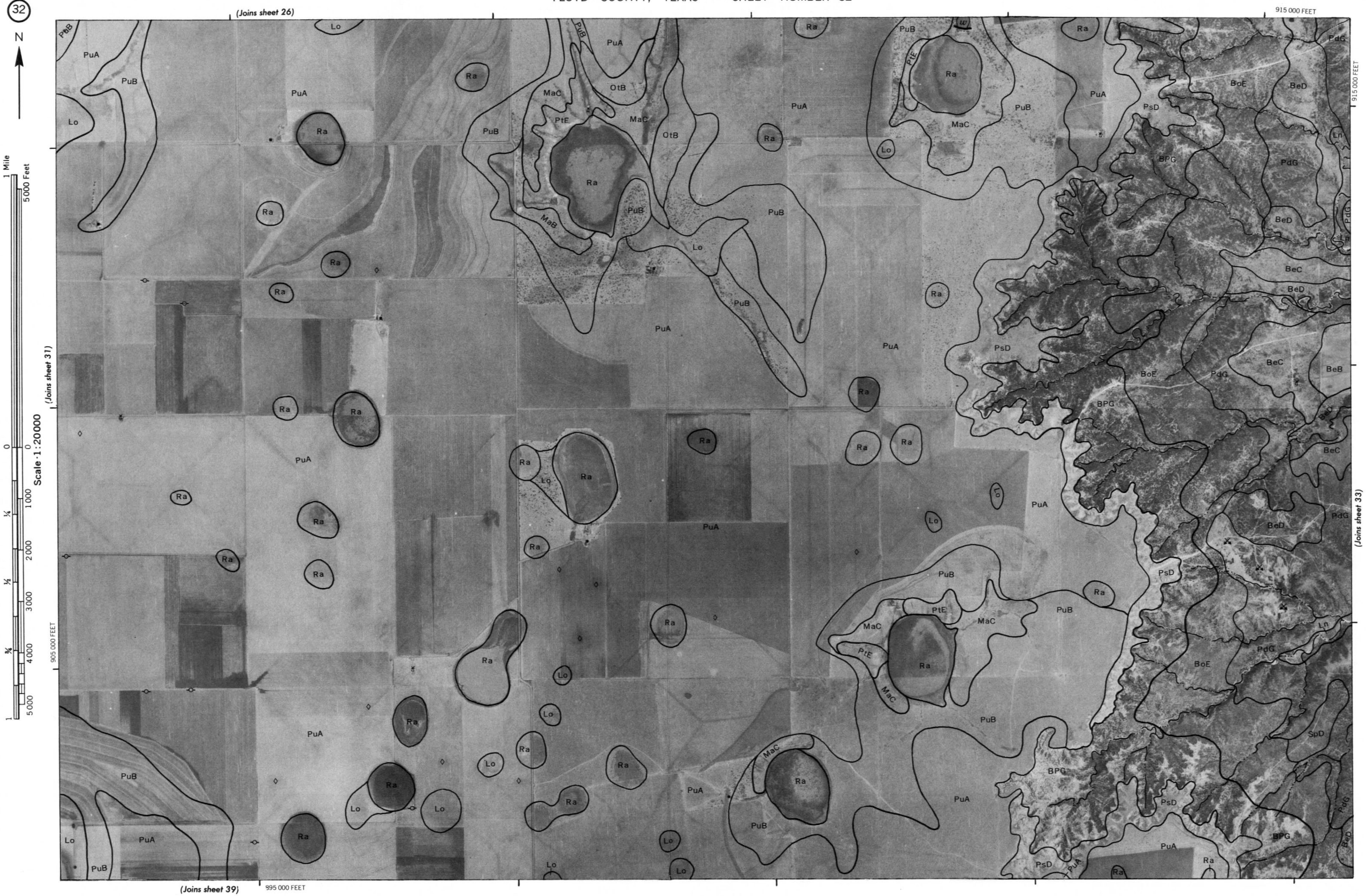

(Joins sheet 22)
(Joins sheet 27)
(Joins sheet 29)
(Joins sheet 35)
N
1 Mile
5000 Feet
Scale 1:20000
815 000 FEET
915 000 FEET
905 000 FEET
795 000 FEET
ATCHISON
TOPEKA
AND
SANTA FE
DENVER
AND
FORT WORTH
LOCKNEY
70
97
378
PuA
PuB
MaB
MaC
OtA
Ra
Lo
EsB
EsA

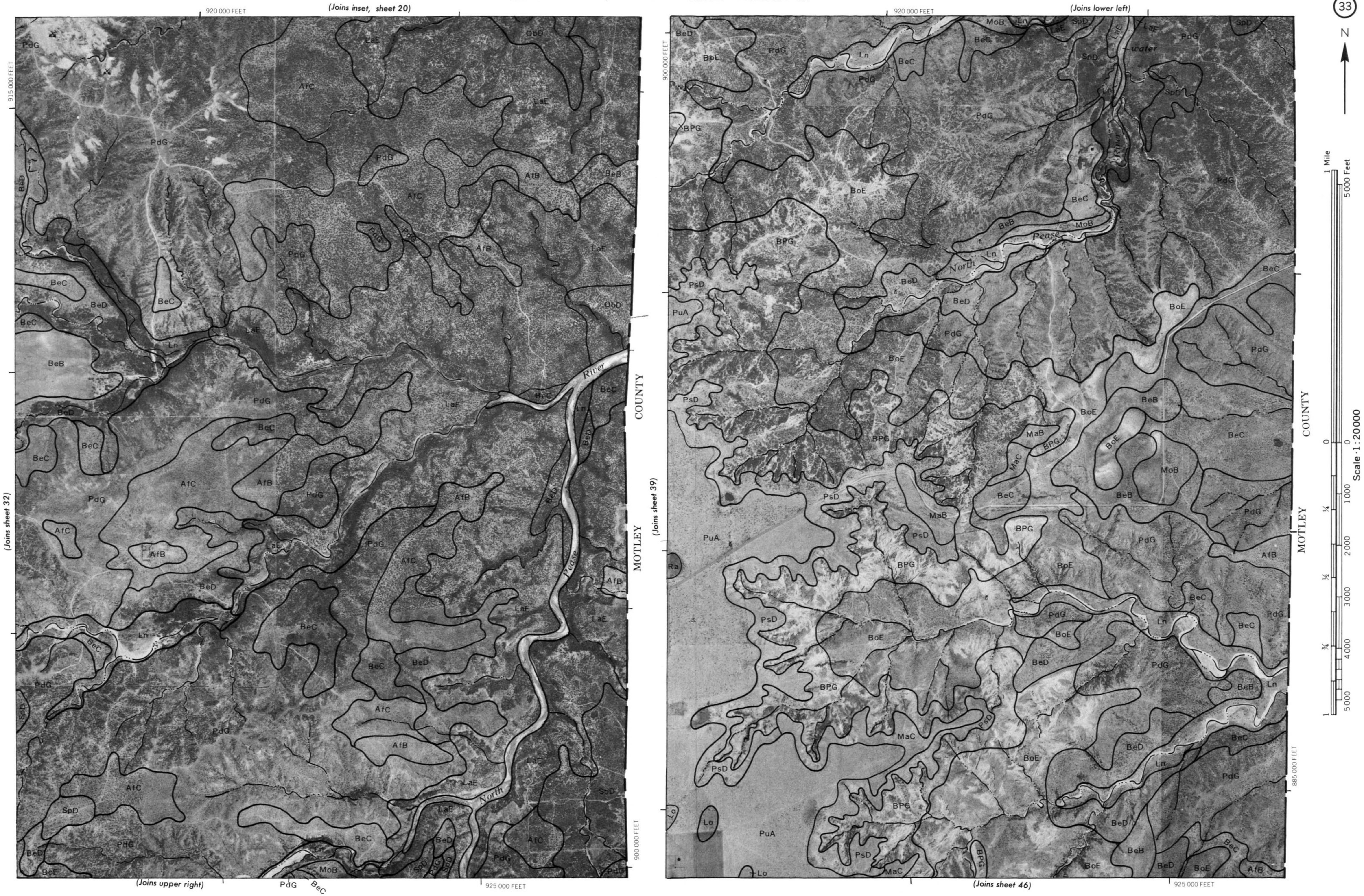

29
N
(Joins sheet 23)
(Joins sheet 30)
(Joins sheet 36)
(Joins sheet 28)
820 000 FEET
915 000 FEET
905 000 FEET
840 000 FEET
97
97
Scale 1:20000
1 Mile
5000 Feet
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
Ra
Lo
PuA
PuB
MaB
MaC
OtA
OtB

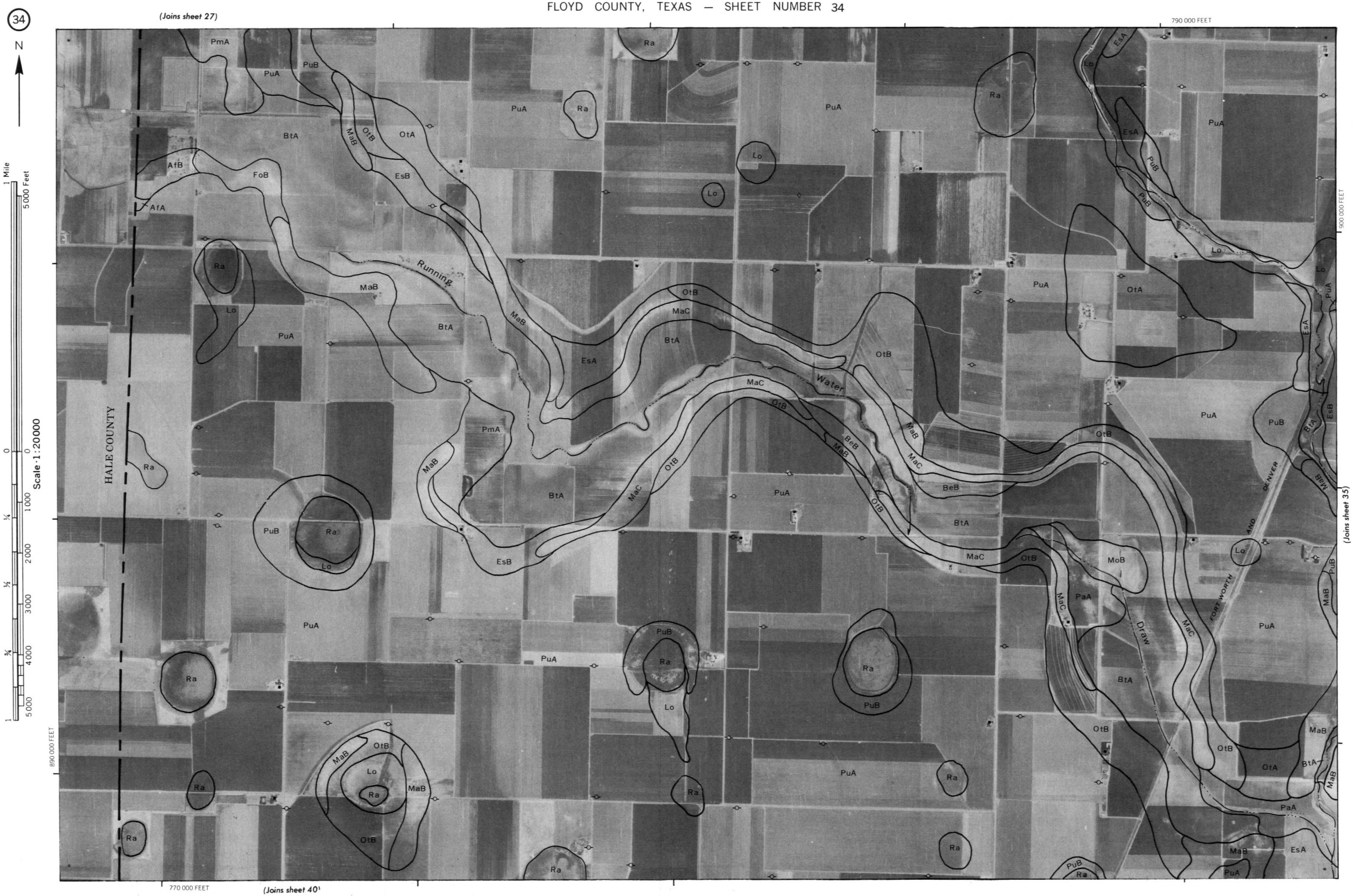

3
N
BRISCOE COUNTY
820 000 FEET
980 000 FEET
970 000 FEET
840 000 FEET
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 10)
FORT WORTH AND DENVER
Ra
PuB
PuA
Lo
FoC
MaC
1 Mile
5000 Feet
Scale 1:20000


30
N
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
(Joins sheet 24)
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 37)
865 000 FEET
915 000 FEET
905 000 FEET
845 000 FEET
97
207
PuB
PuA
MaC
Ra
Lo
OtB
MaB
DrC
EsA
EsB

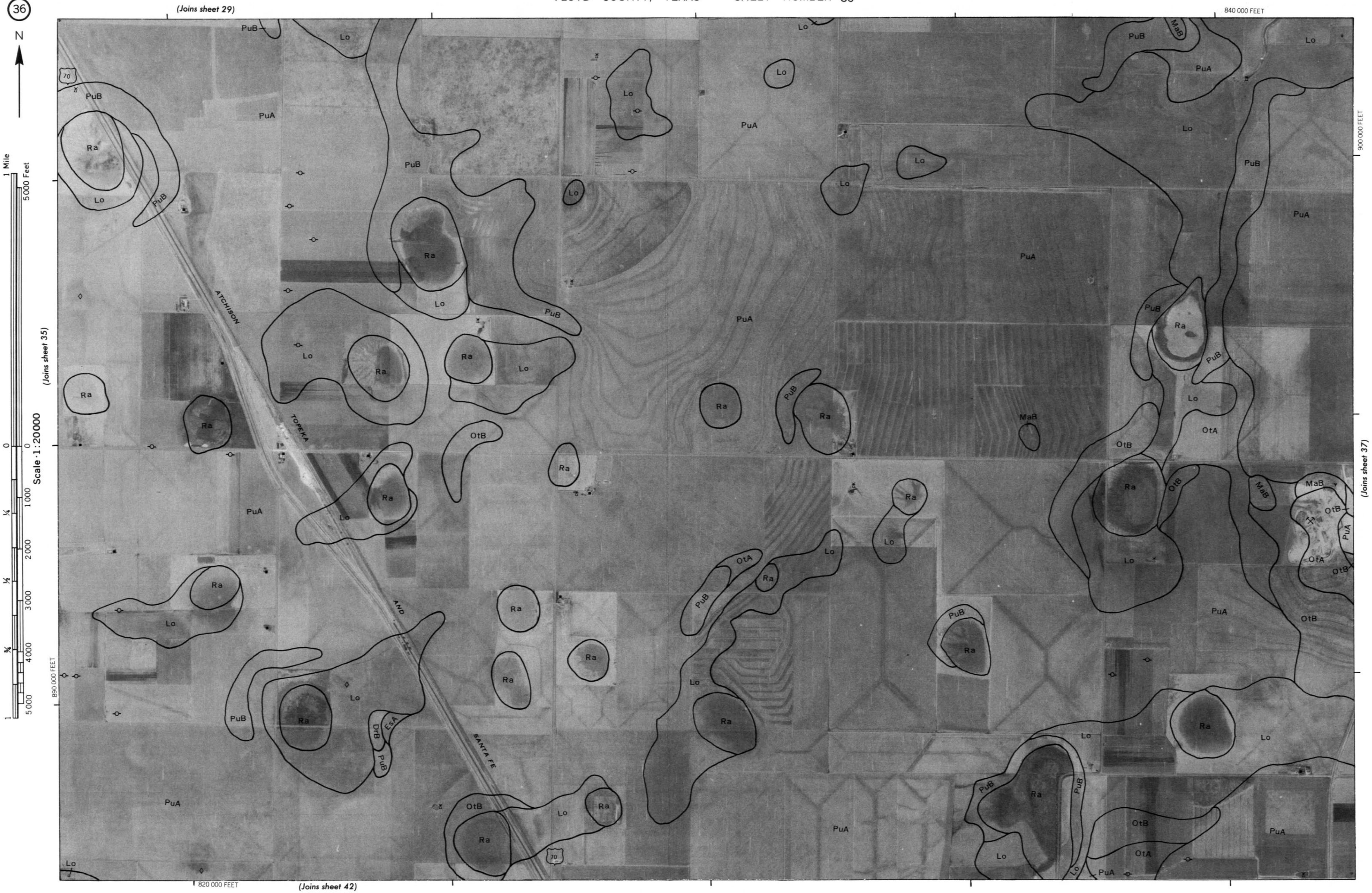

31
N
(Joins sheet 25)
(Joins sheet 32)
(Joins sheet 38)
(Joins sheet 30)
870 000 FEET
915 000 FEET
905 000 FEET
890 000 FEET
1 Mile
5000 Feet
Scale 1:20000
Ra
MaC
PuB
PuA
Lo
OtA
OtB
MaB

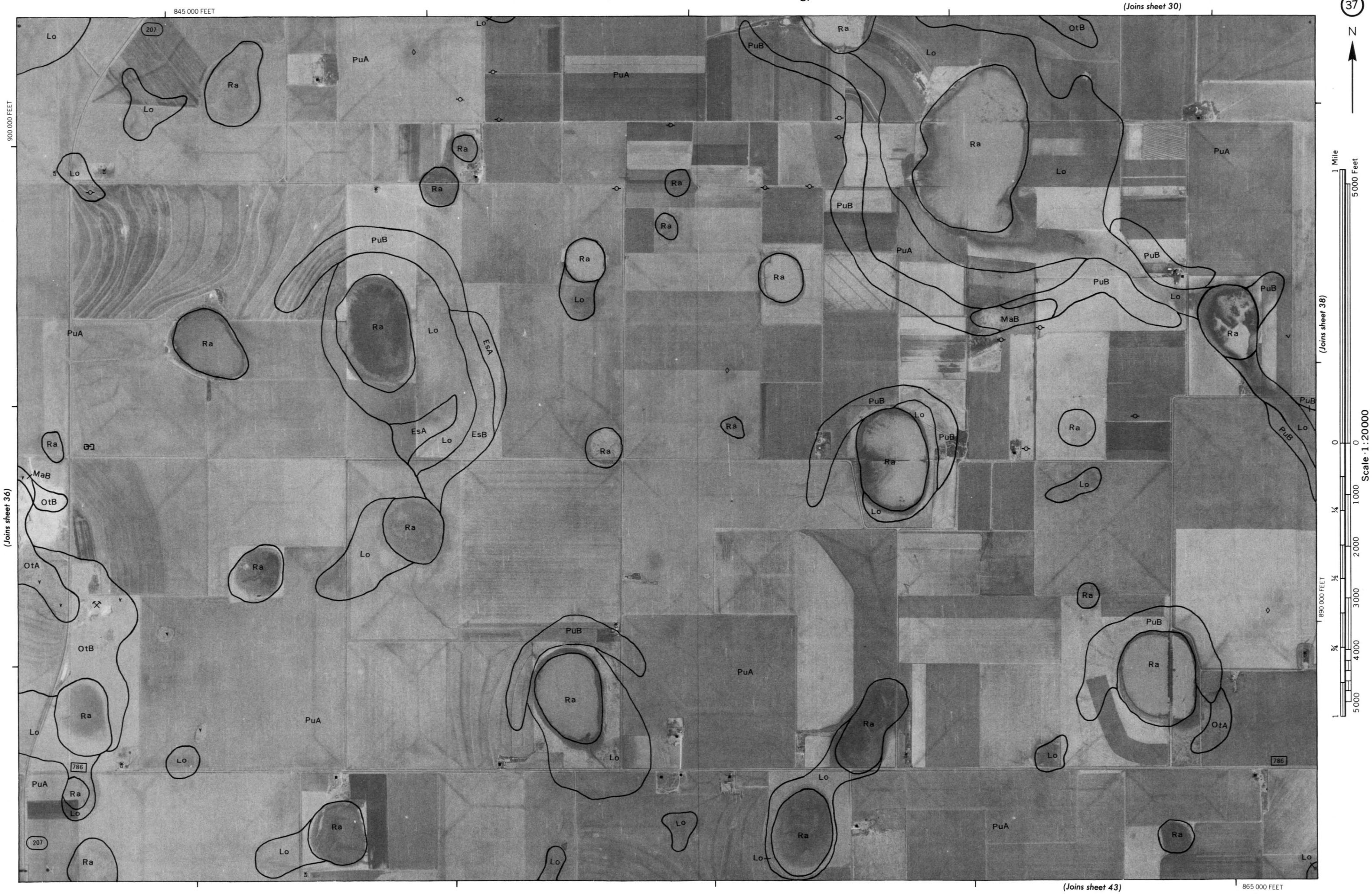

32
N
(Joins sheet 26)
(Joins sheet 31)
(Joins sheet 33)
(Joins sheet 39)
915 000 FEET
915 000 FEET
905 000 FEET
995 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
0
¼
½
¾
1


33
N
(Joins inset, sheet 20)
(Joins lower left)
(Joins sheet 32)
(Joins sheet 39)
(Joins upper right)
(Joins sheet 46)
920 000 FEET
925 000 FEET
915 000 FEET
900 000 FEET
885 000 FEET
MOTLEY COUNTY
North Pease River
Scale 1:20000
1 Mile
5000 Feet
0
1/4
1/2
3/4
1
1000
2000
3000
4000
5000


34
N
(Joins sheet 27)
790 000 FEET
900 000 FEET
(Joins sheet 35)
770 000 FEET
(Joins sheet 40)
890 000 FEET
1 Mile
5 000 Feet
Scale 1:20000
HALE COUNTY
Running
Water
Draw
FORT WORTH AND DENVER
PmA
PuA
PuB
BtA
AfB
AfA
FoB
MaB
OtB
OtA
EsB
EsA
Ra
Lo
MaC
BeB
PmA
MoB
PaA

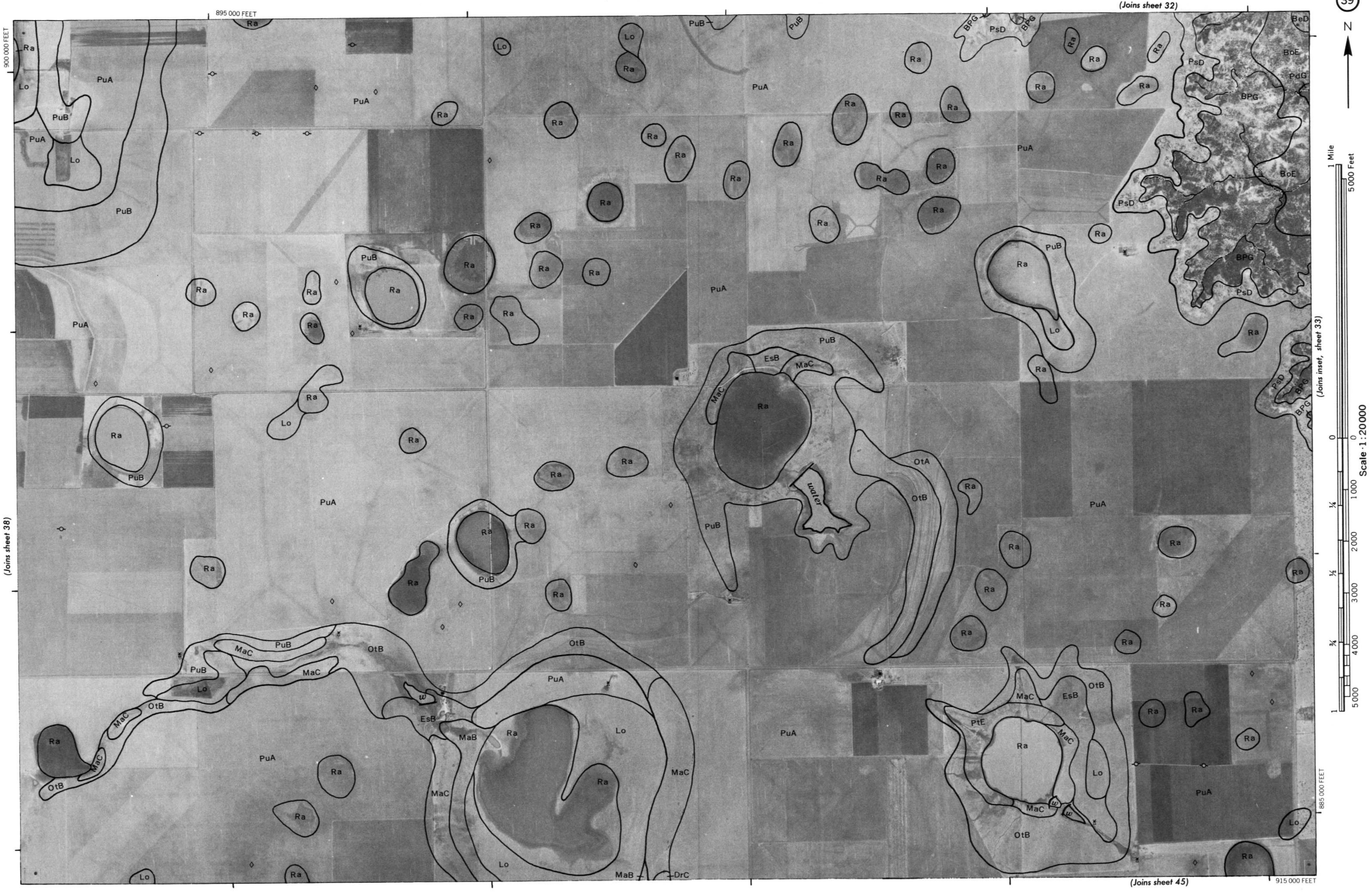

795 000 FEET
(Joins sheet 28)
N
1 Mile
5000 Feet
Scale 1:20000
0
1/4
1/2
3/4
1
0
1000
2000
3000
4000
5000
(Joins sheet 36)
(Joins sheet 34)
(Joins sheet 41)
815 000 FEET
900 000 FEET
890 000 FEET
FORT WORTH AND DENVER
378
70
PuA
PuB
Lo
Ra
OtA
OtB
EsA
EsB
MaB
DrB
DrC
BtA
PmA
PaA


(Joins sheet 29)
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 42)
N
840 000 FEET
900 000 FEET
890 000 FEET
820 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
70
ATCHISON
TOPEKA
AND
SANTA FE
PuA
PuB
Lo
Ra
OtA
OtB
MaB
DrB
EsA


37
N
845 000 FEET
900 000 FEET
(Joins sheet 30)
(Joins sheet 38)
(Joins sheet 36)
(Joins sheet 43)
865 000 FEET
890 000 FEET
1 Mile
5000 Feet
Scale 1:20000
207
786
Lo
Ra
PuA
PuB
OtB
OtA
EsA
EsB
MaB


N
(Joins sheet 31)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 44)
890 000 FEET
900 000 FEET
885 000 FEET
870 000 FEET
1 Mile
5000 Feet
Scale 1:20000
786
602
PuA
PuB
Ra
Lo
OtB
OtA
EsB
EsA
DrB
DrC
MaB
MaC

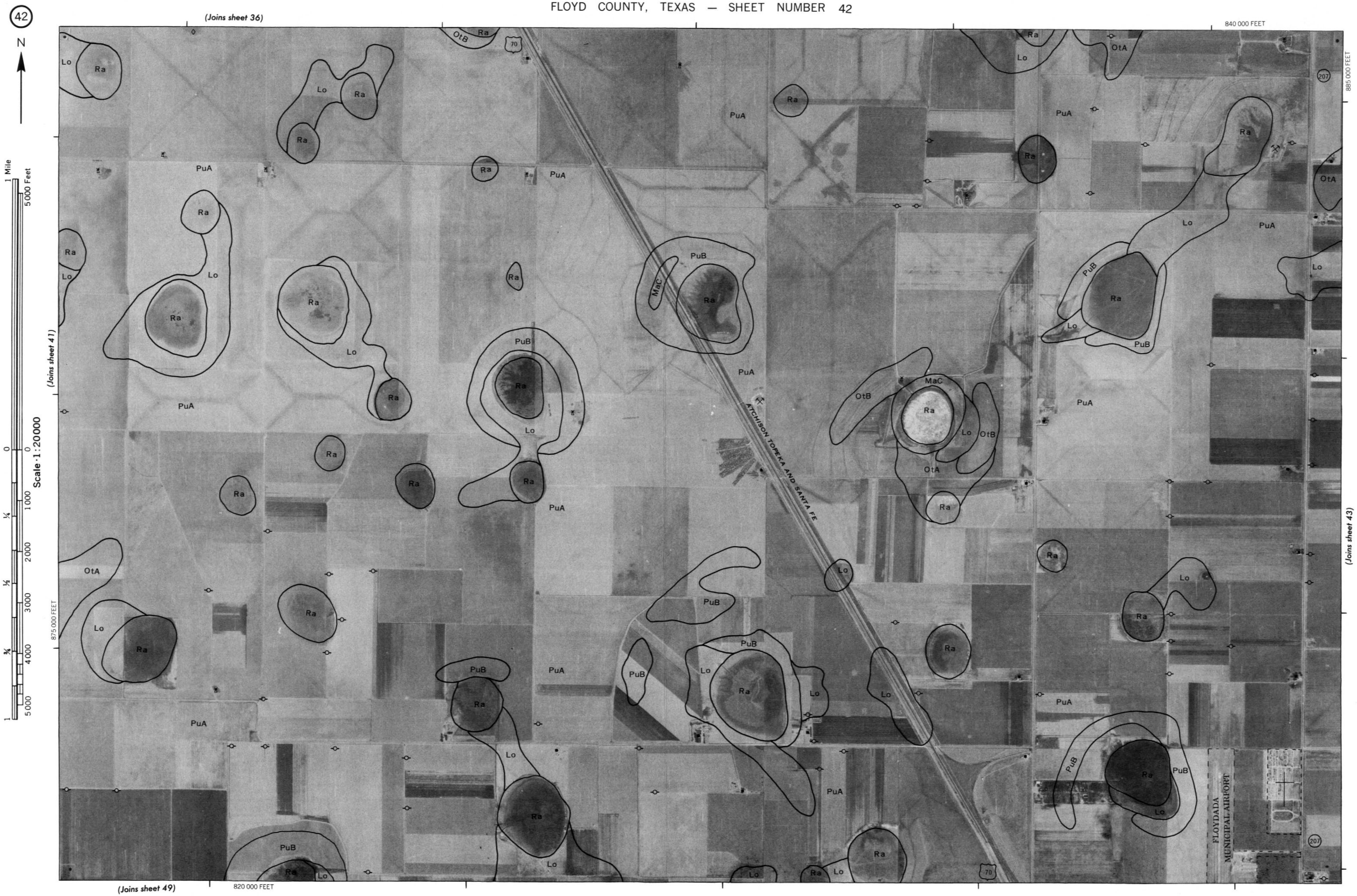
FLOYD COUNTY, TEXAS — SHEET NUMBER 39

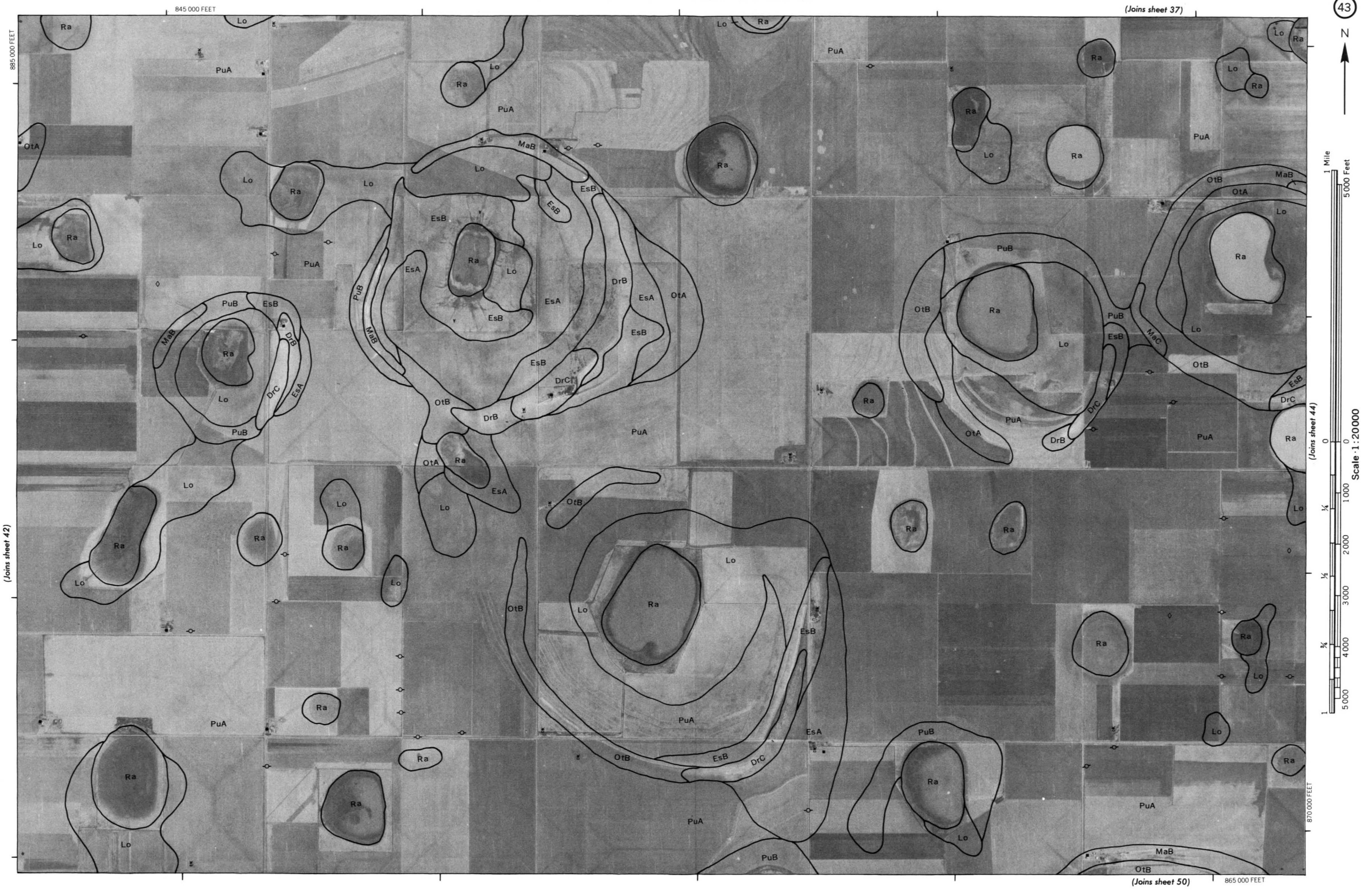


FLOYD COUNTY, TEXAS — SHEET NUMBER 4


N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
0
¼
½
¾
1
(Joins sheet 34)
(Joins sheet 41)
(Joins sheet 47)
790 000 FEET
885 000 FEET
875 000 FEET
770 000 FEET
HALE COUNTY
Callahan
Draw
Running Water Draw
FORT WORTH AND DENVER
Barwise
784
PuA
PuB
Ra
Lo
EsB
EsA
MaC
MaB
BtA
OtB
OtA
PaA
PtE

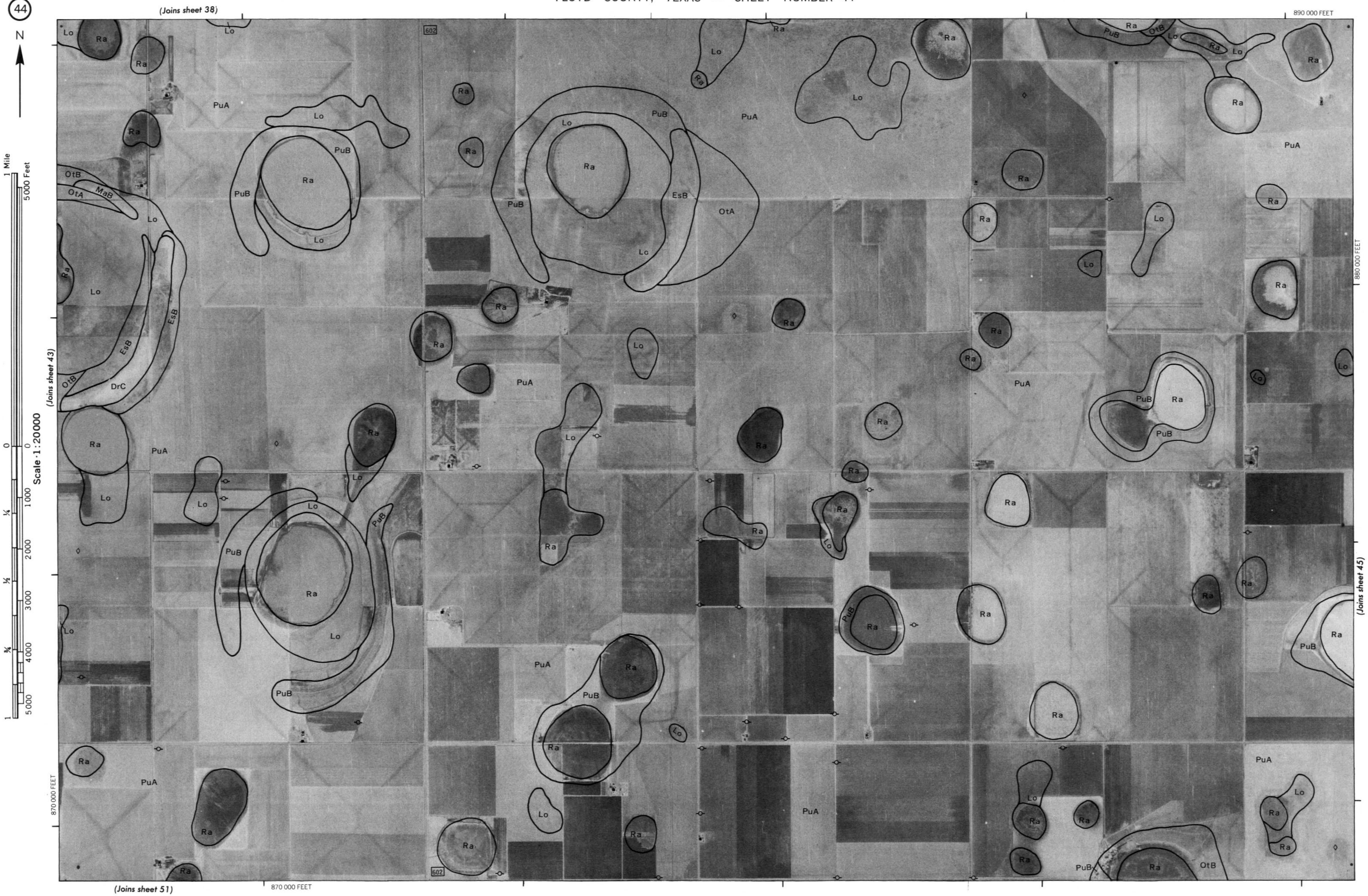

41
N
(Joins sheet 35)
(Joins sheet 40)
(Joins sheet 42)
(Joins sheet 48)
795 000 FEET
885 000 FEET
845 000 FEET
815 000 FEET
378
EsA
PaA
BtA
OtB
OtA
MaB
PuA
PuB
Ra
Lo
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
1000
2000
3000
4000
5000


42
N
(Joins sheet 36)
(Joins sheet 41)
(Joins sheet 43)
(Joins sheet 49)
840 000 FEET
885 000 FEET
875 000 FEET
820 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
1000
2000
3000
4000
5000
ATCHISON TOPEKA AND SANTA FE
FLOYDADA MUNICIPAL AIRPORT
70
207
Ra
Lo
PuA
PuB
OtA
OtB
MaC

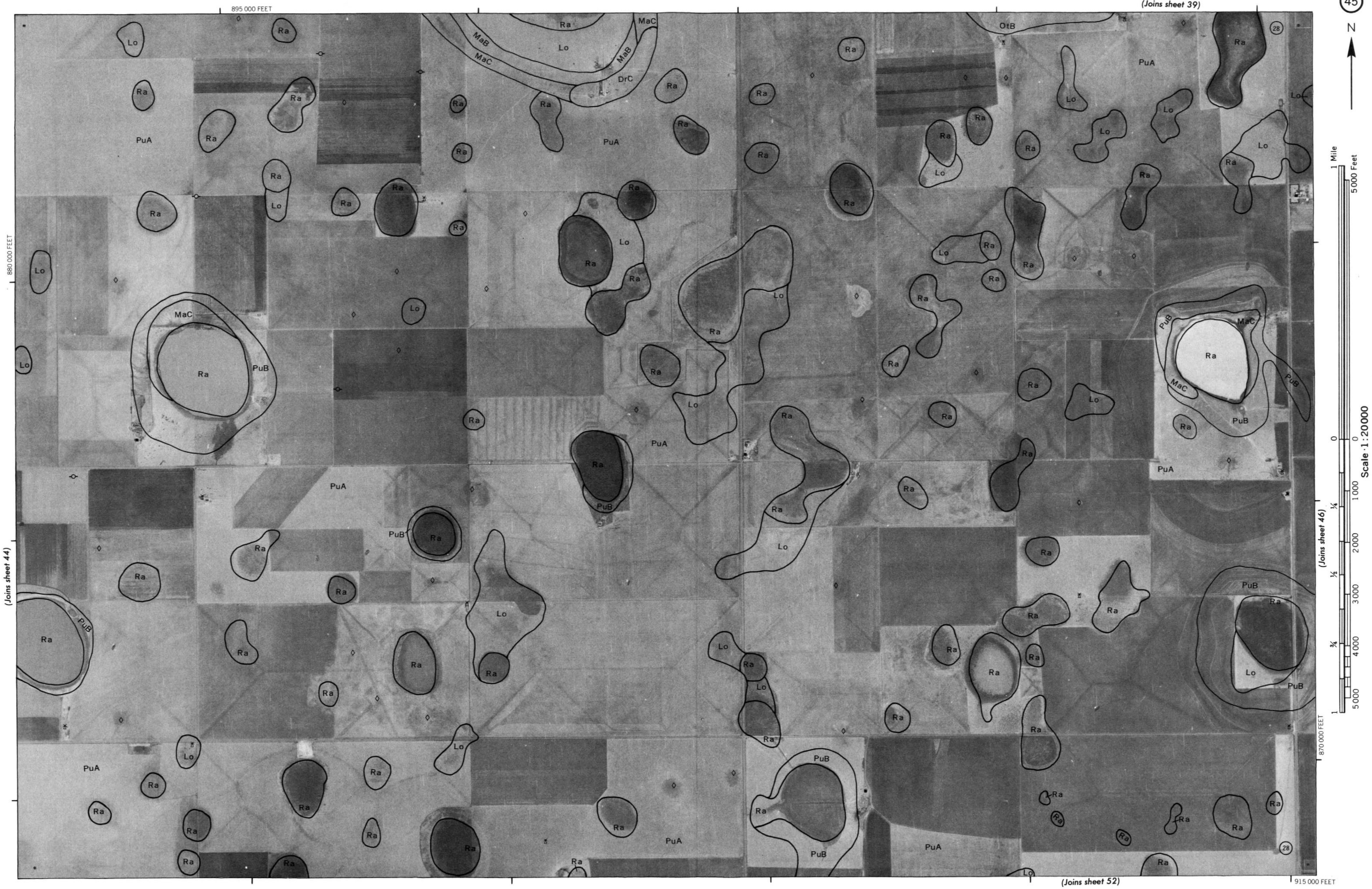

43
N
845 000 FEET
885 000 FEET
(Joins sheet 37)
(Joins sheet 42)
(Joins sheet 44)
(Joins sheet 50)
865 000 FEET
870 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
Ra
Lo
PuA
PuB
OtA
OtB
MaB
MaC
EsA
EsB
DrB
DrC

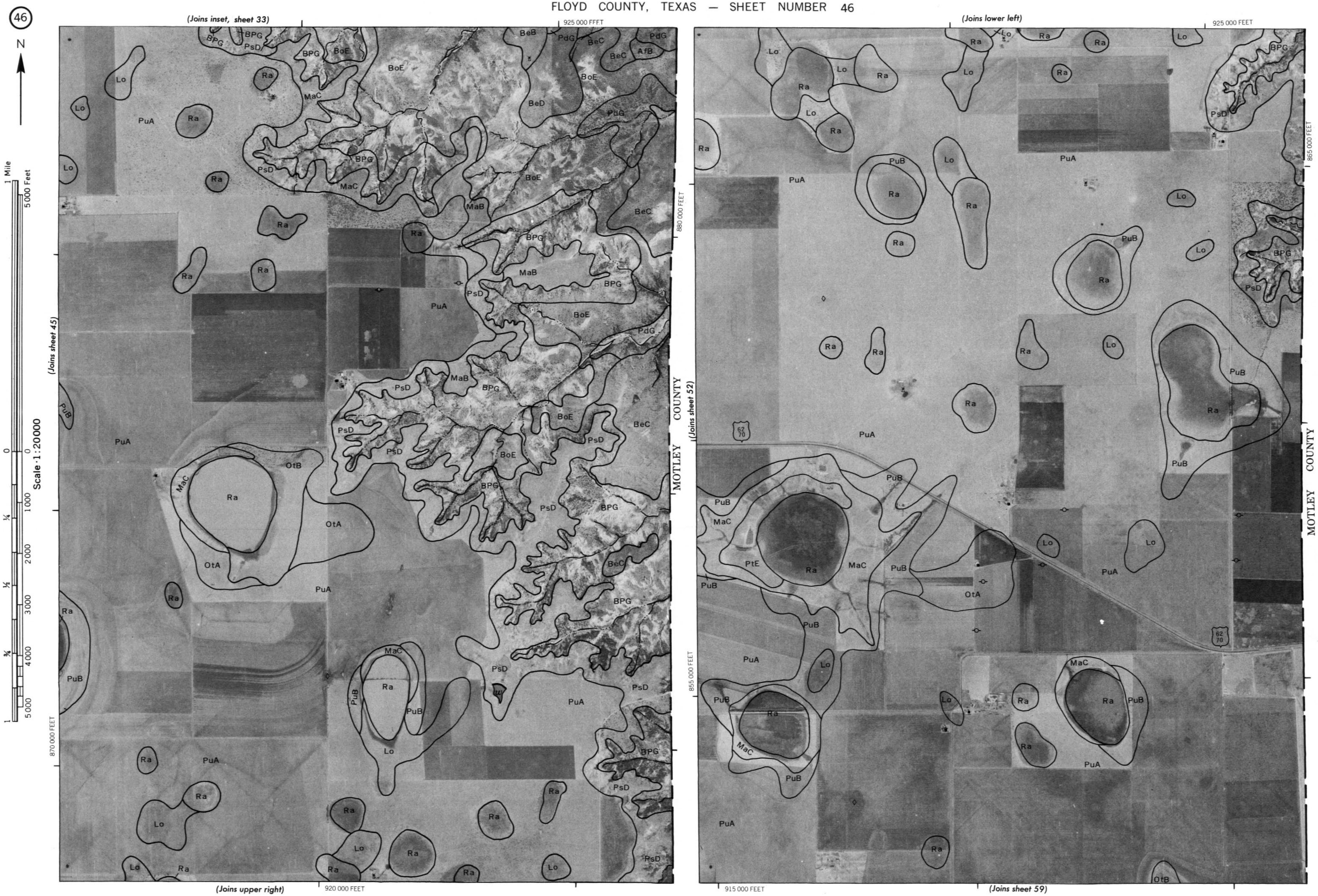
44

FLOYD COUNTY, TEXAS — SHEET NUMBER 44



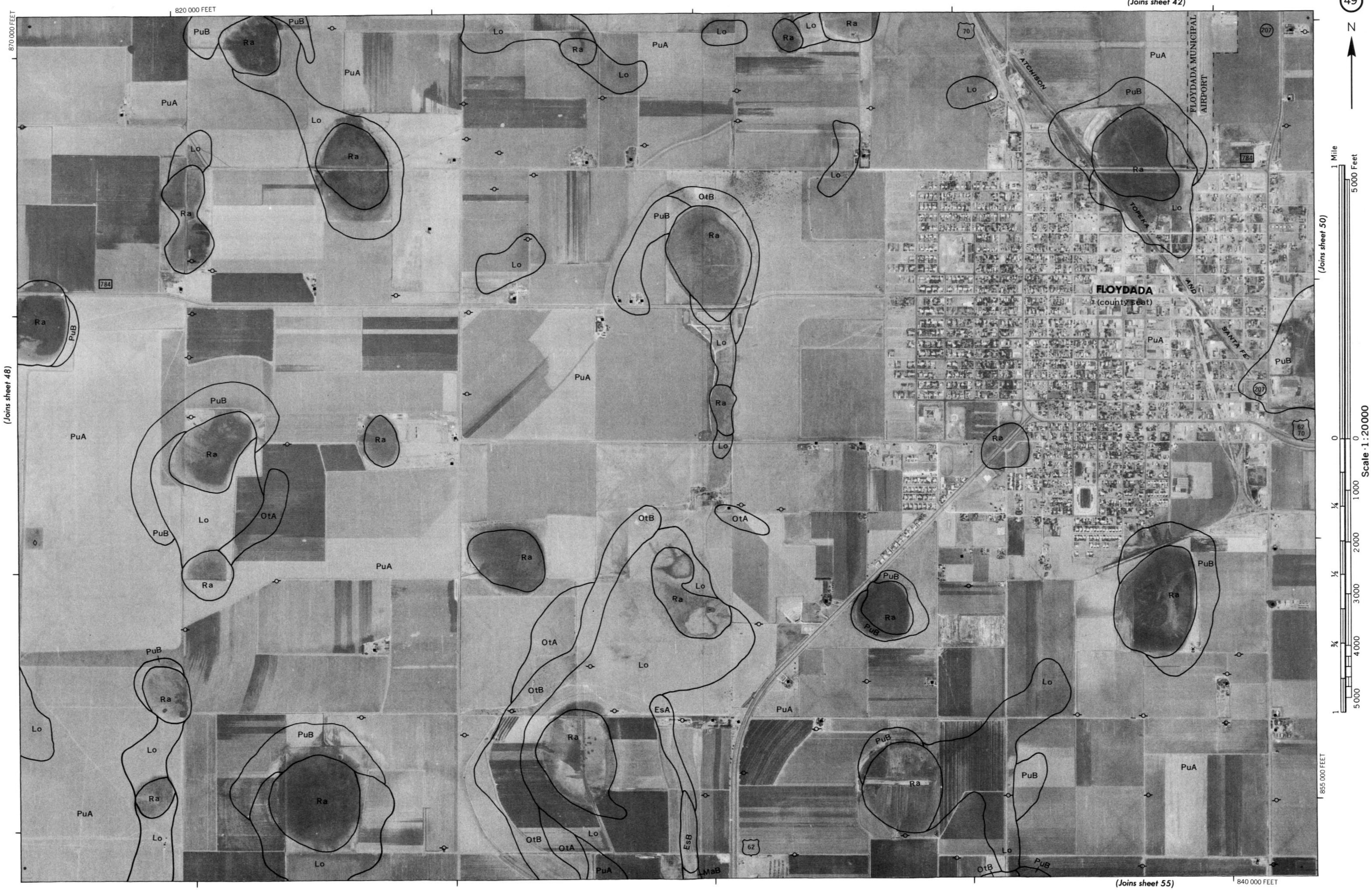
FLOYD COUNTY, TEXAS — SHEET NUMBER 45



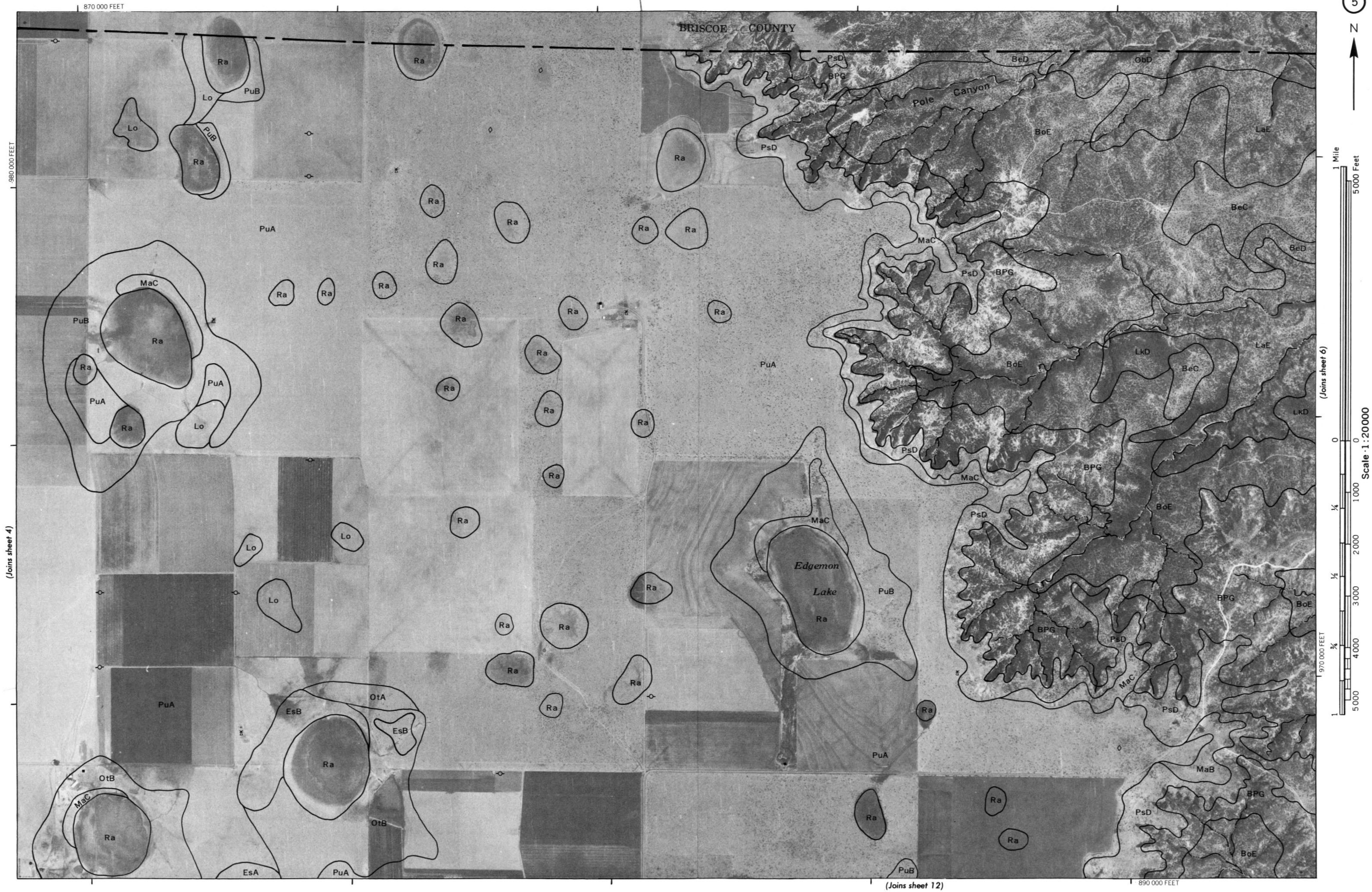

46
N
(Joins inset, sheet 33)
925 000 FEET
(Joins lower left)
925 000 FEET
(Joins sheet 45)
(Joins sheet 52)
880 000 FEET
865 000 FEET
855 000 FEET
870 000 FEET
MOTLEY COUNTY
MOTLEY COUNTY
1 Mile
5 000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
(Joins upper right)
920 000 FEET
915 000 FEET
(Joins sheet 59)
62
70

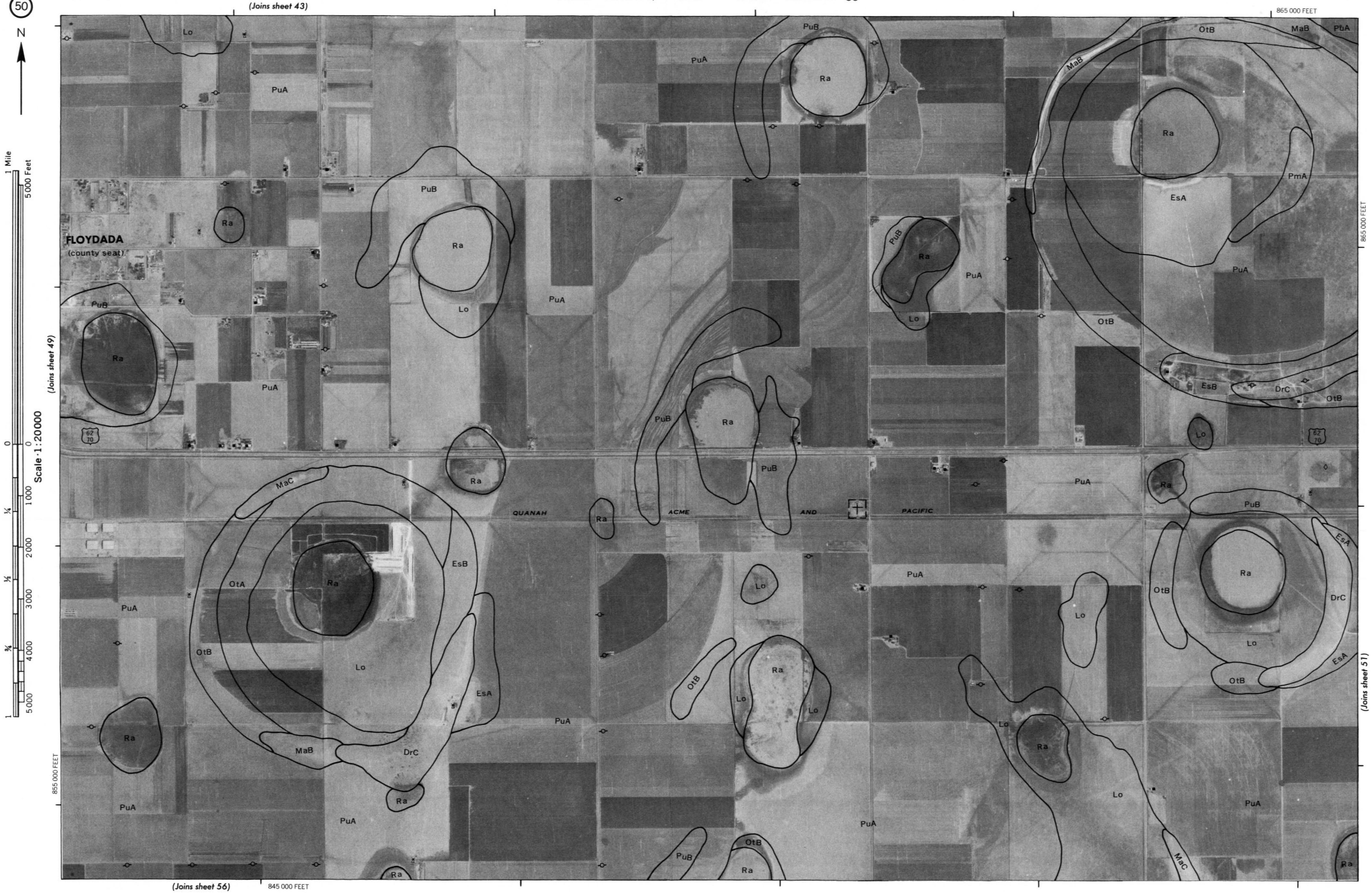

47
N
(Joins sheet 40)
(Joins sheet 48)
(Joins sheet 53)
770 000 FEET
790 000 FEET
870 000 FEET
855 000 FEET
Barwise
784
DENVER
AND
FORT WORTH
HALE COUNTY
Callahan
Draw
Running
Water
Draw
Ra
Lo
PuA
PuB
OtA
OtB
MaB
MaC
BtA
DrB
EsA
AfA
AfB
FoB
PaA
PtE
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
1
Scale 1:20000

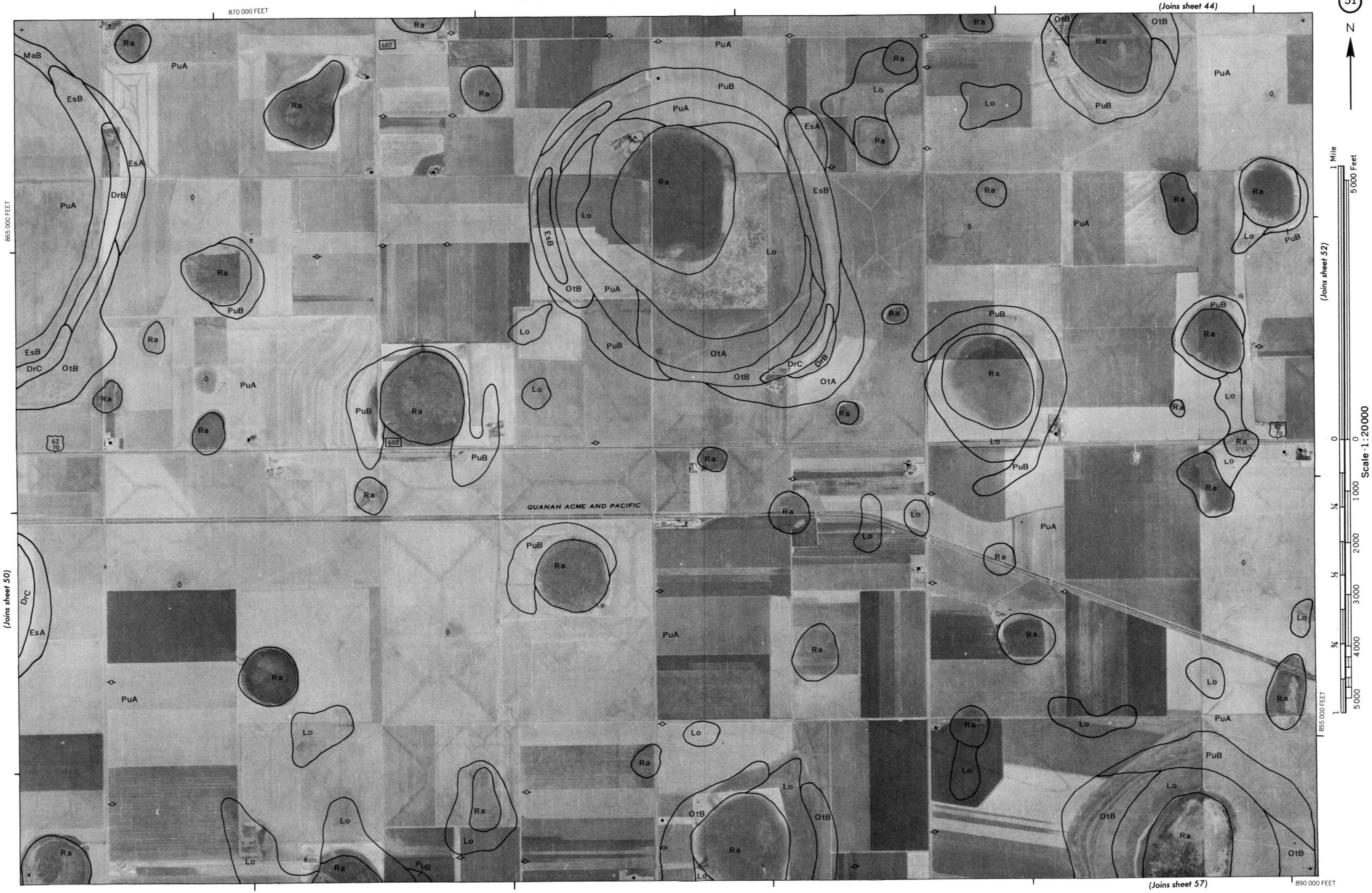

48
N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
(Joins sheet 41)
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 54)
815 000 FEET
870 000 FEET
855 000 FEET
795 000 FEET
378
784
Sandhill
White
River
Bois d'Arc Lake
OtA
Ra
PmA
PuA
Lo
PuB
AfA
AfB
FoB
FoC
MaB
MaC
PaA
OtB
BtA
BeC
BeD
BeB
PtE


49
N
820 000 FEET
870 000 FEET
(Joins sheet 42)
(Joins sheet 48)
(Joins sheet 50)
(Joins sheet 55)
840 000 FEET
855 000 FEET
FLOYDADA
(county seat)
FLOYDADA MUNICIPAL AIRPORT
ATCHISON
TOPEKA
AND
SANTA FE
784
70
207
62
PuA
PuB
Ra
Lo
OtA
OtB
EsA
EsB
MaB
Scale 1:20000
1 Mile
5000 Feet
0
¼
½
¾
1
1000
2000
3000
4000
5000

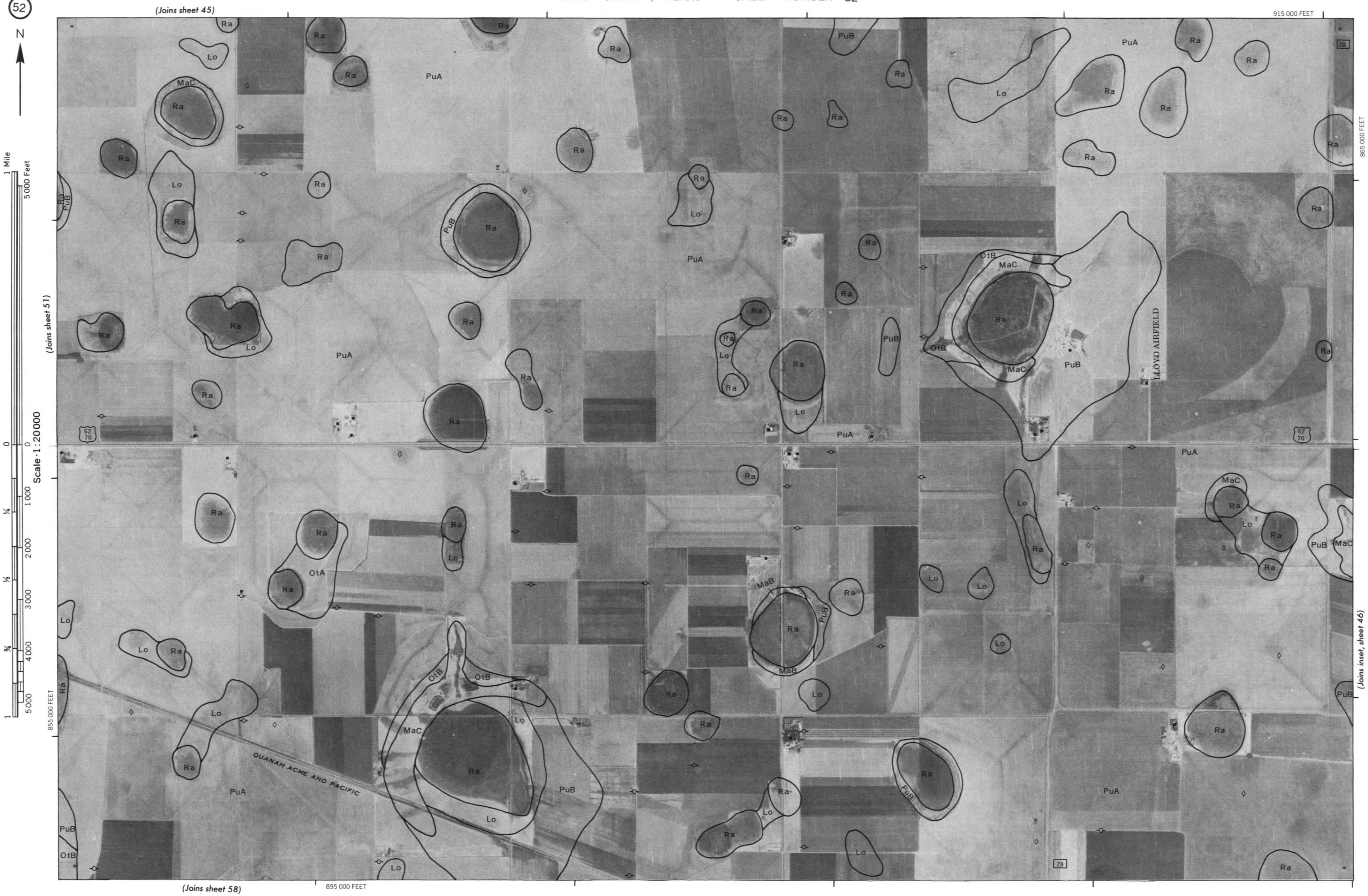
FLOYD COUNTY, TEXAS — SHEET NUMBER 5



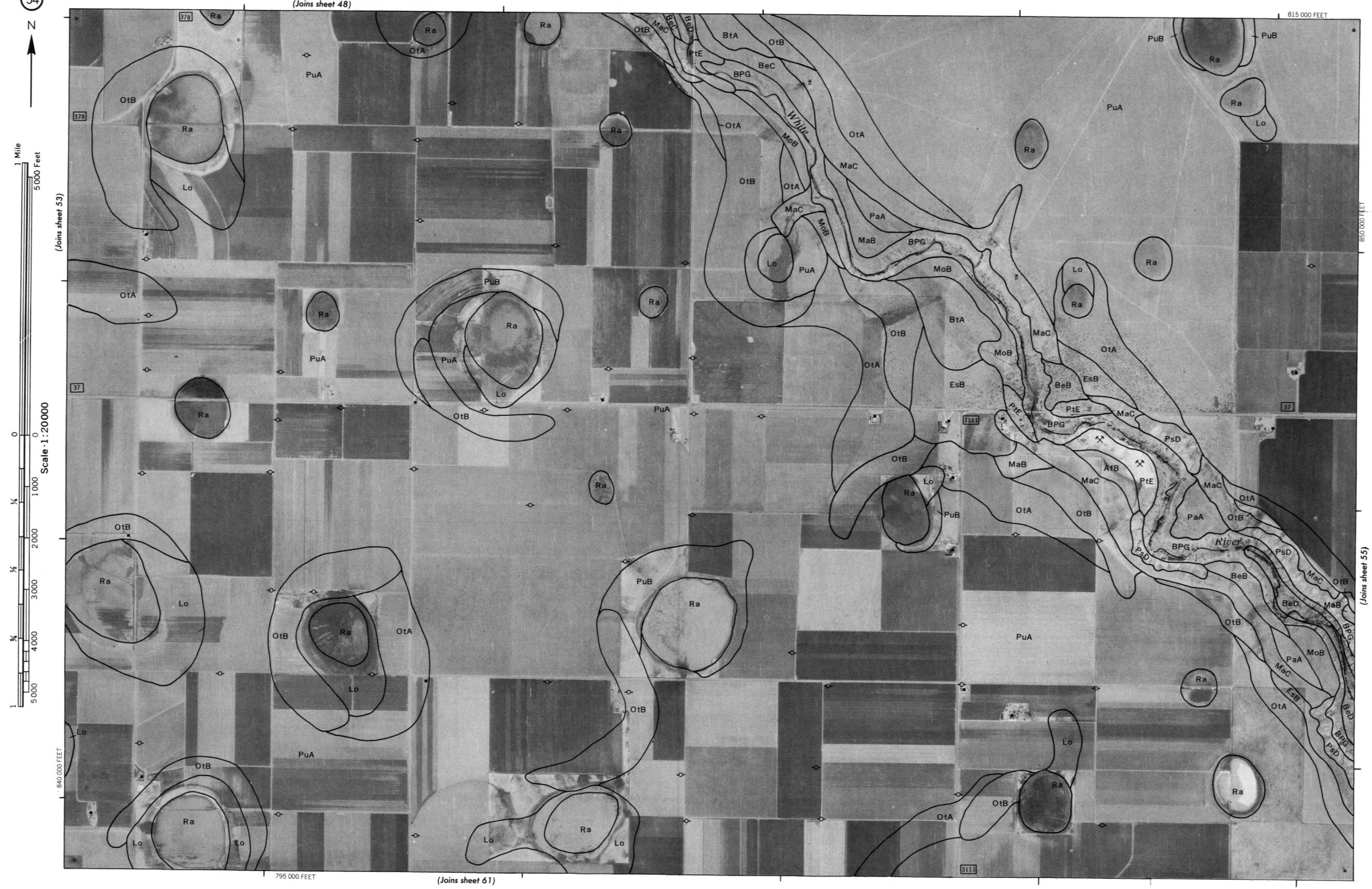

50
N
(Joins sheet 43)
(Joins sheet 49)
(Joins sheet 51)
(Joins sheet 56)
865 000 FEET
845 000 FEET
855 000 FEET
1 Mile
5000 Feet
Scale 1:20000
FLOYDADA
(county seat)
QUANAH
ACME
AND
PACIFIC
62
70
Lo
PuA
PuB
Ra
OtB
MaB
PmA
EsA
EsB
DrC
MaC
OtA



51
N
(Joins sheet 44)
(Joins sheet 52)
(Joins sheet 50)
(Joins sheet 57)
870 000 FEET
865 000 FEET
855 000 FEET
890 000 FEET
QUANAH ACME AND PACIFIC
602
62
70
MaB
EsB
EsA
DrB
DrC
OtB
OtA
PuA
PuB
Ra
Lo
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
1000
2000
3000
4000
5000

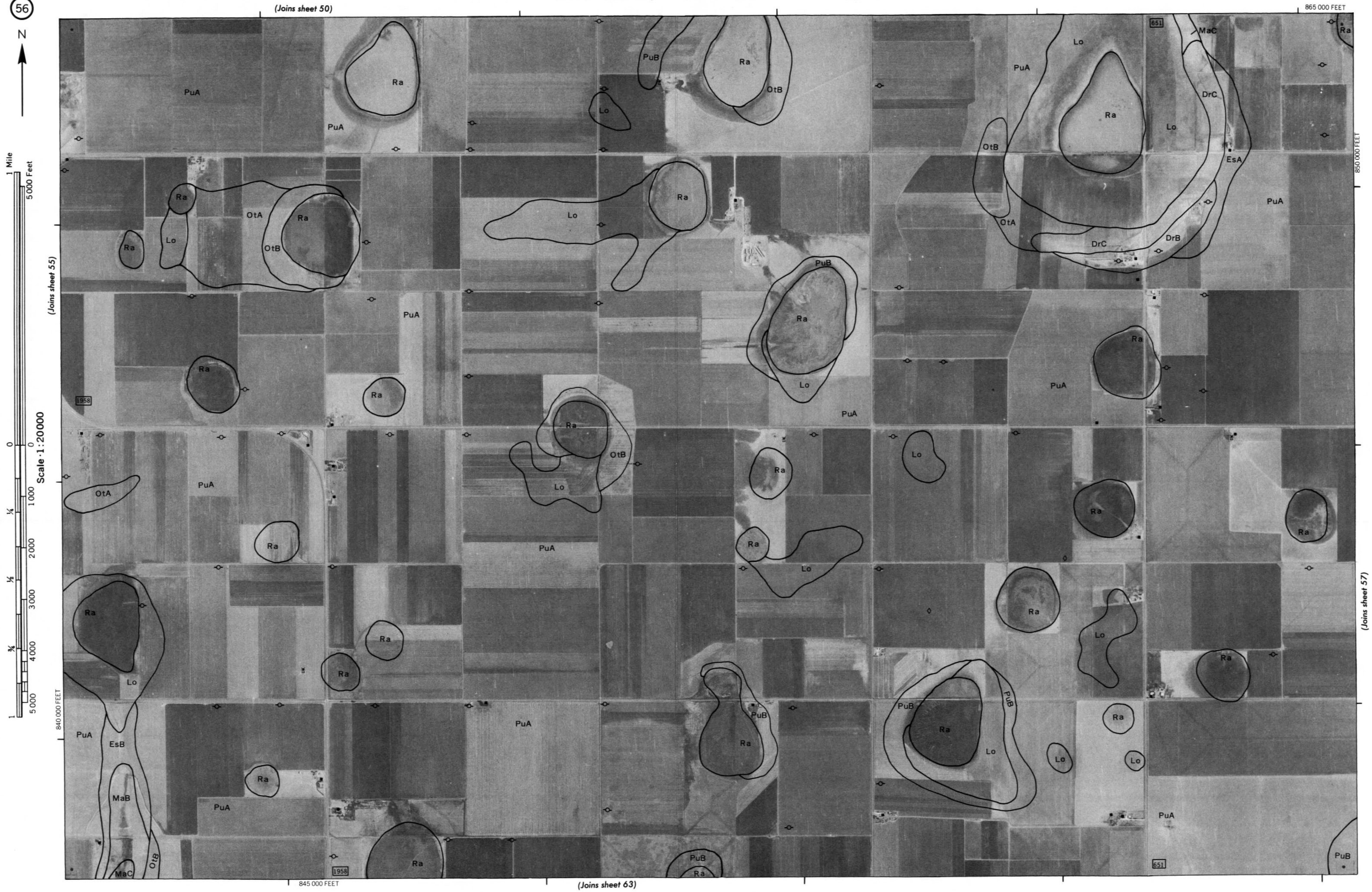

N
(Joins sheet 45)
(Joins sheet 51)
(Joins sheet 58)
(Joins inset, sheet 46)
915 000 FEET
865 000 FEET
855 000 FEET
895 000 FEET
Scale 1:20000
1 Mile
5000 Feet
LLOYD AIRFIELD
QUANAH ACME AND PACIFIC
PuA
PuB
Ra
Lo
MaC
MaB
OtA
OtB

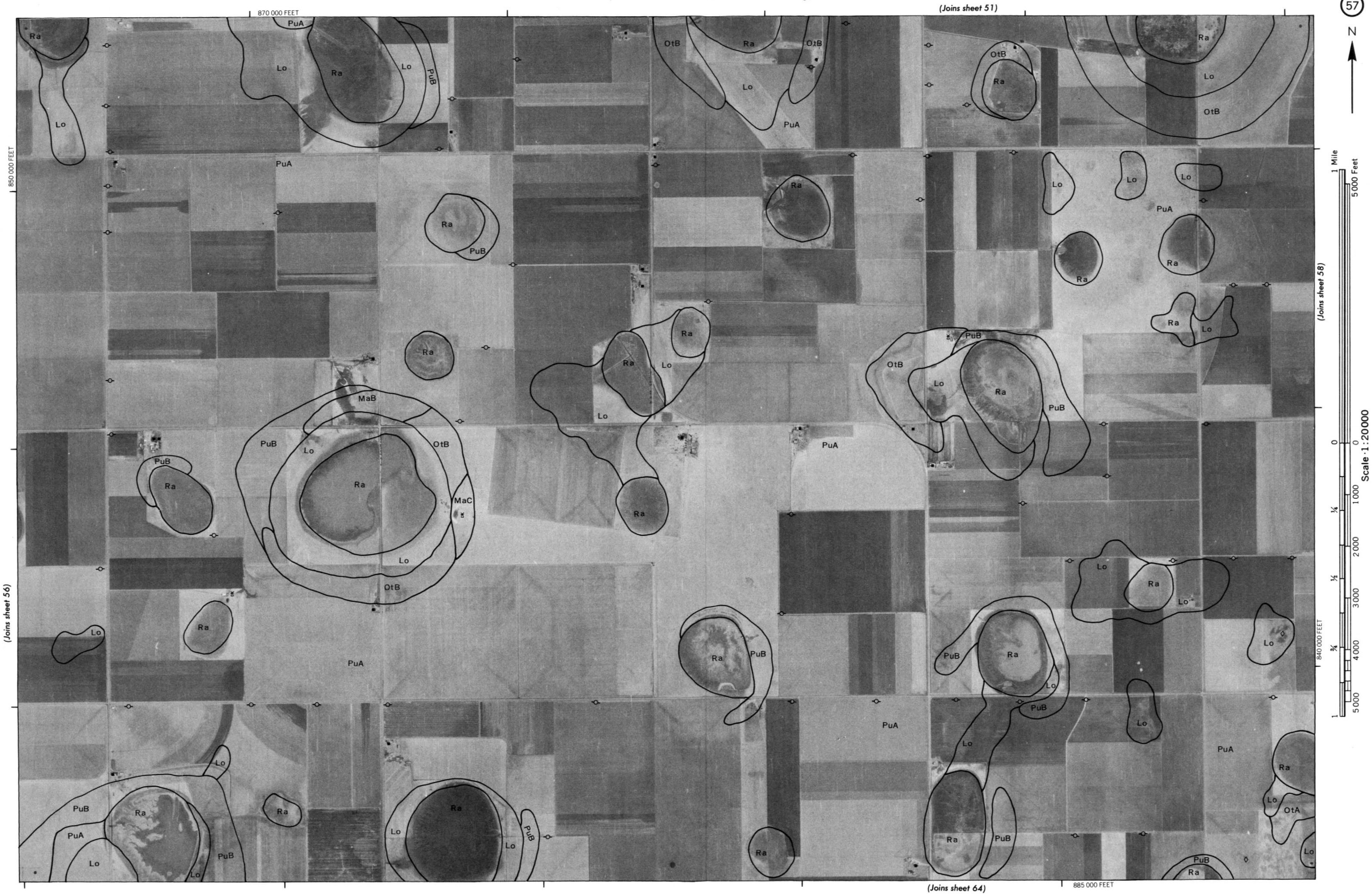

53
N
(Joins sheet 47)
(Joins sheet 54)
(Joins sheet 60)
770 000 FEET
790 000 FEET
855 000 FEET
840 000 FEET
HALE COUNTY
FORT WORTH AND DENVER
Crawfish Draw
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
37
378
PuA
OtA
OtB
Ra
Lo
PuB
MaB
MaC
BtA
EsA
EsB

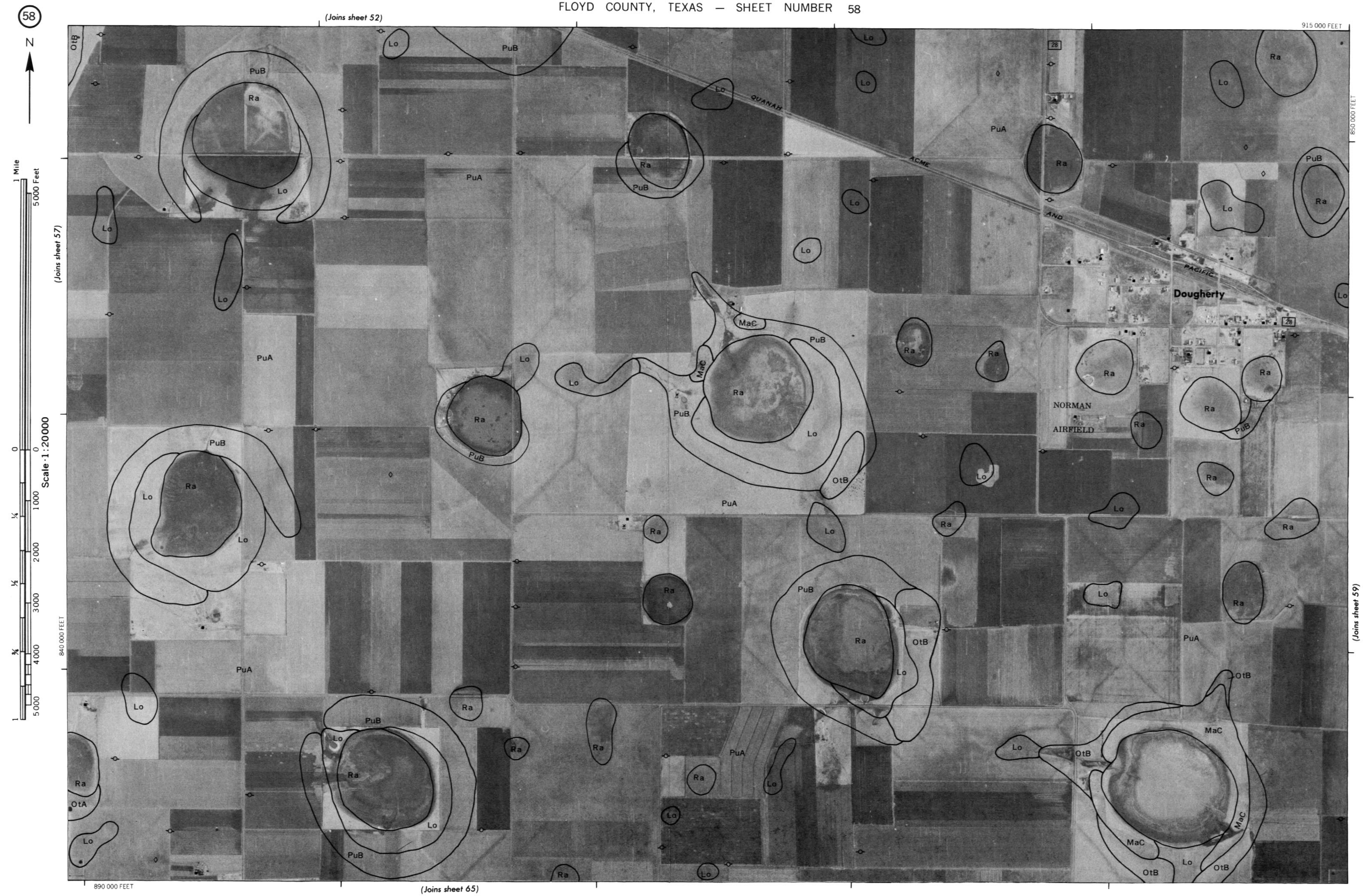

(Joins sheet 48)
(Joins sheet 53)
(Joins sheet 55)
(Joins sheet 61)
N
Scale 1:20000
1 Mile
5000 Feet
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
815 000 FEET
850 000 FEET
840 000 FEET
795 000 FEET
378
37
3111
White
River
PuA
PuB
Ra
Lo
OtA
OtB
MaC
MaB
MoB
BeC
BsD
BtA
PtE
BPG
PaA
EsB
BeB
PsD
AtB
BeD


55
N
820 000 FEET
(Joins sheet 49)
(Joins sheet 56)
(Joins sheet 54)
(Joins sheet 62)
850 000 FEET
840 000 FEET
840 000 FEET
1 Mile
5000 Feet
Scale 1:20000
62
37
1958
White River

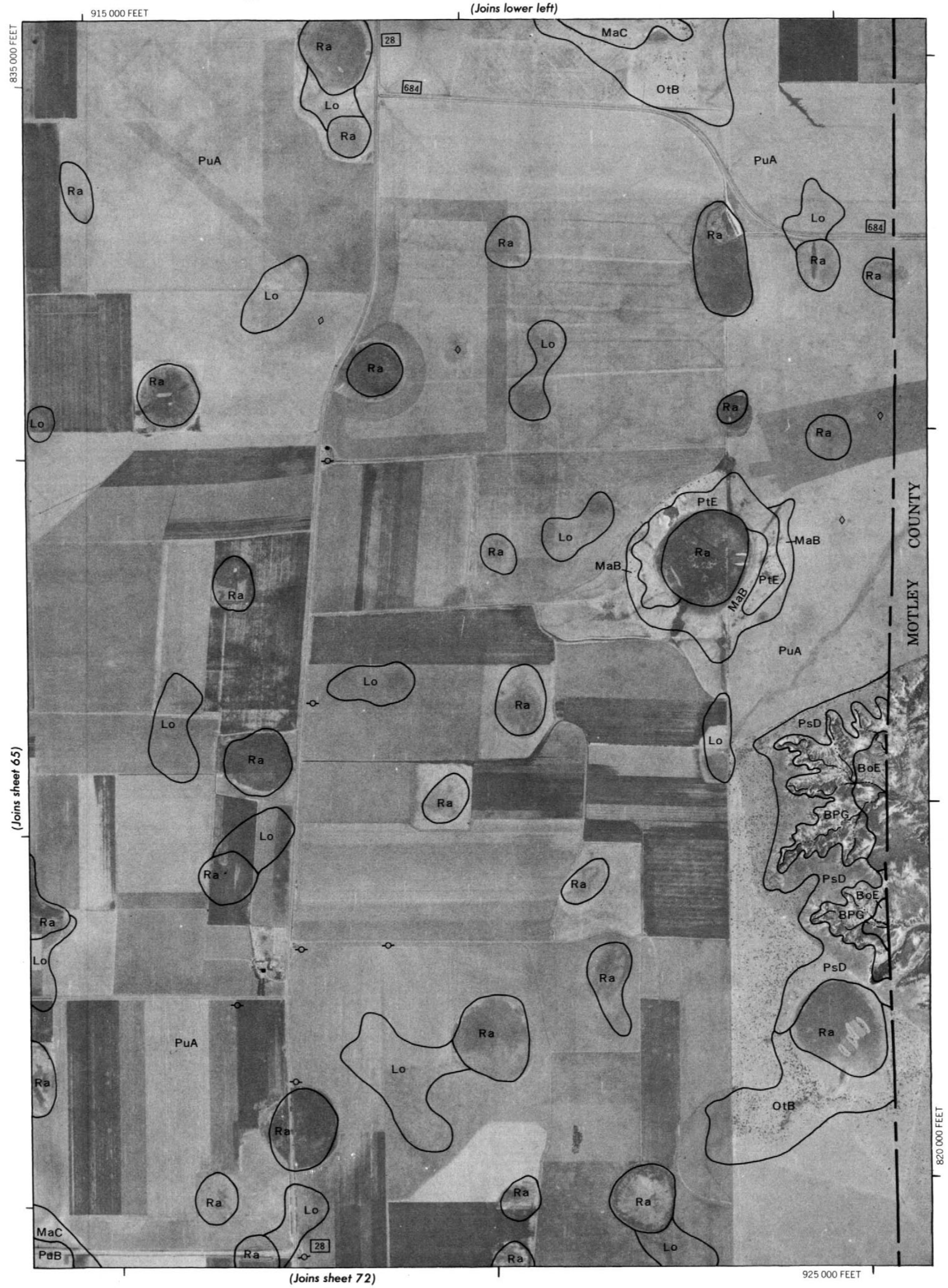
FLOYD COUNTY, TEXAS — SHEET NUMBER 56

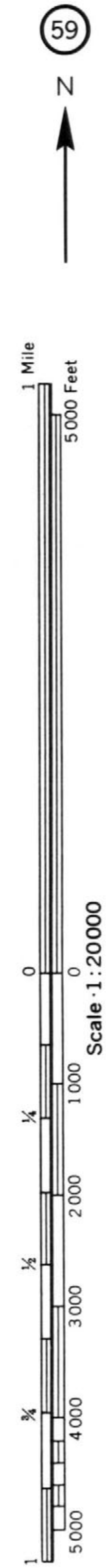



57
N
(Joins sheet 51)
(Joins sheet 58)
(Joins sheet 64)
(Joins sheet 56)
870 000 FEET
850 000 FEET
840 000 FEET
885 000 FEET
1 Mile
5000 Feet
Scale 1:20000
Ra
Lo
PuA
PuB
OtB
OtA
MaB
MaC

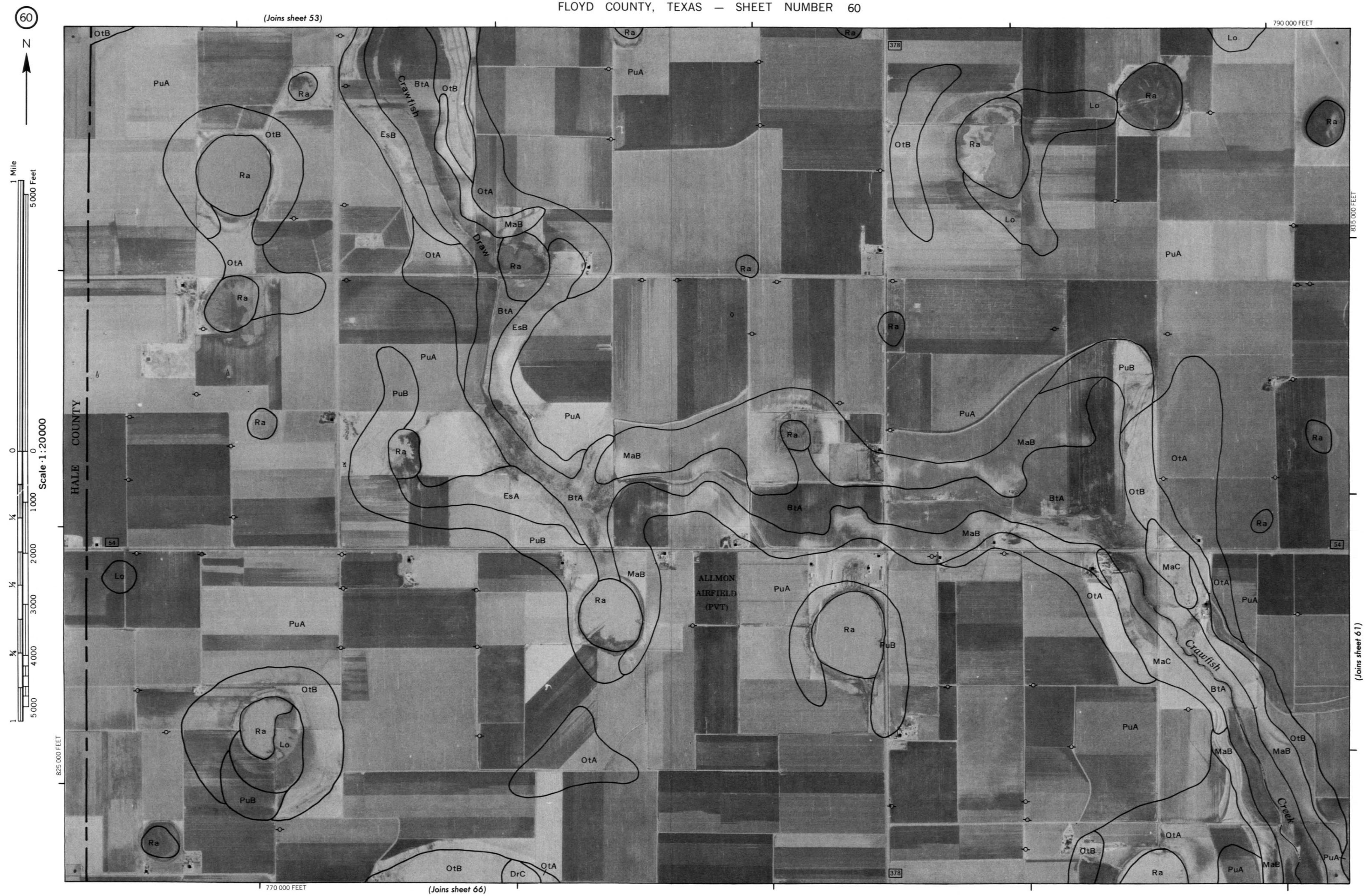

(Joins sheet 52)
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 65)
N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
915 000 FEET
850 000 FEET
840 000 FEET
890 000 FEET
QUANAH ACME AND PACIFIC
28
Dougherty
NORMAN AIRFIELD
PuA
PuB
Ra
Lo
MaC
OtB
OtA


(Joins inset, sheet 46)
915 000 FEET
850 000 FEET
(Joins sheet 58)
(Joins upper right)
925 000 FEET
MOTLEY COUNTY
QUANAH
ACME
AND
PACIFIC
28
Ra
PuA
PuB
OtB
MaC
PtE
Lo
MaB


(Joins lower left)
915 000 FEET
835 000 FEET
840 000 FEET
820 000 FEET
(Joins sheet 65)
(Joins sheet 72)
925 000 FEET
MOTLEY COUNTY
28
684
Ra
Lo
PuA
OtB
MaC
PtE
MaB
PsD
BoE
BPG
PdB


N
1 Mile
5000 Feet
0
¼
½
¾
1
1000
2000
3000
4000
5000
Scale 1:20000

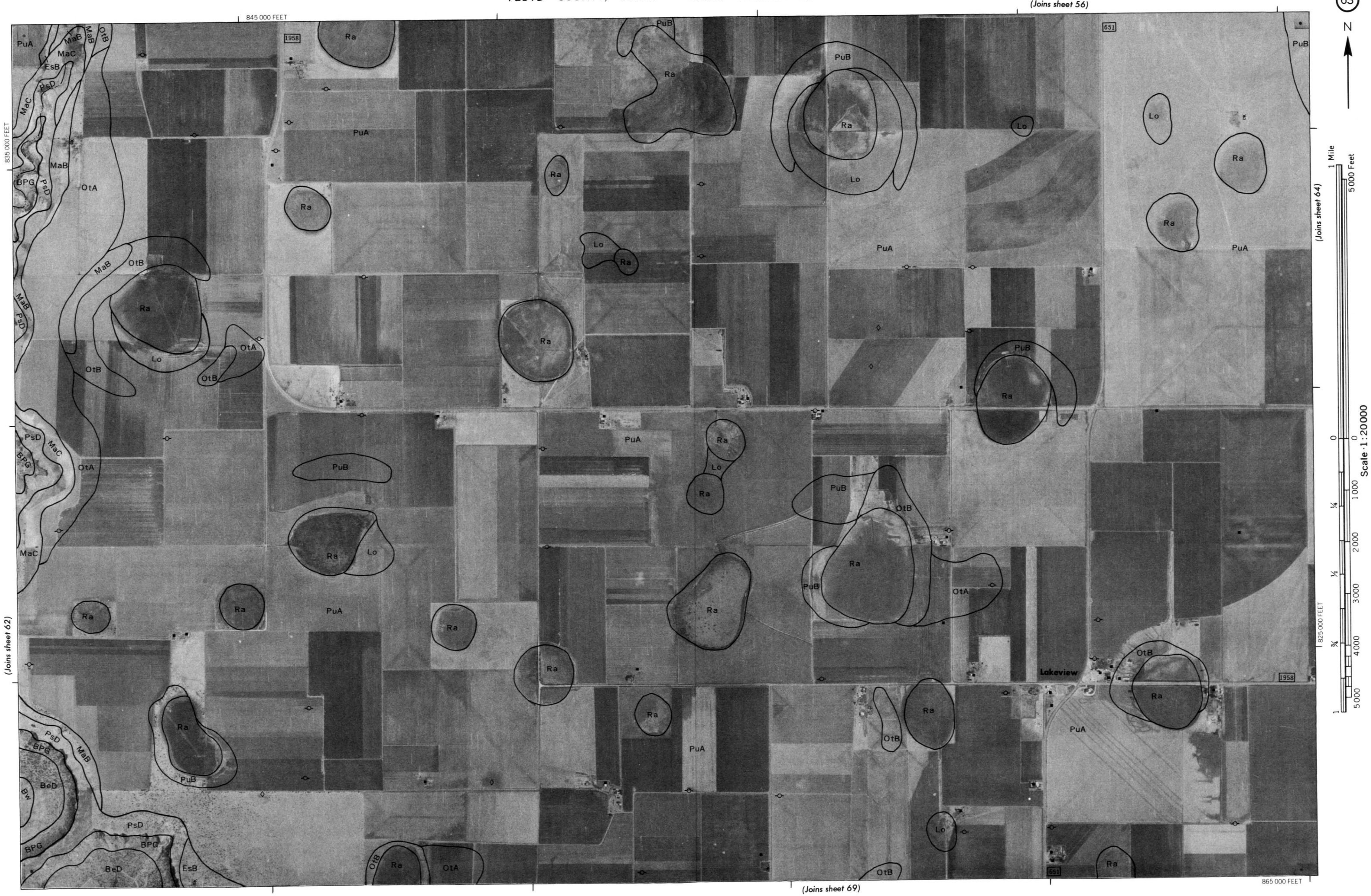

6
N
BRISCOE COUNTY
915 000 FEET
980 000 FEET
970 000 FEET
895 000 FEET
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 13)
Scale 1:20000
1 Mile
5000 Feet
Long Hollow
Hackberry Creek
Quitaque Creek
FORT WORTH AND DENVER
ObD
BeB
BeC
BeD
LaE
PaA
AfA
AfB
AfC
FoB
FoC
FoD
OtA
Lo
Ra
LkD
BoE
BPG
PsD
SpD
Ln
PtE
PdG


(Joins sheet 53)
(Joins sheet 61)
(Joins sheet 66)
790 000 FEET
835 000 FEET
825 000 FEET
770 000 FEET
N
1 Mile
5 000 Feet
Scale 1:20000
HALE COUNTY
Crawfish Draw
Crawfish Creek
ALLMON AIRFIELD (PVT)
PuA
PuB
Ra
OtB
OtA
BtA
EsB
EsA
MaB
MaC
Lo
DrC
378
54

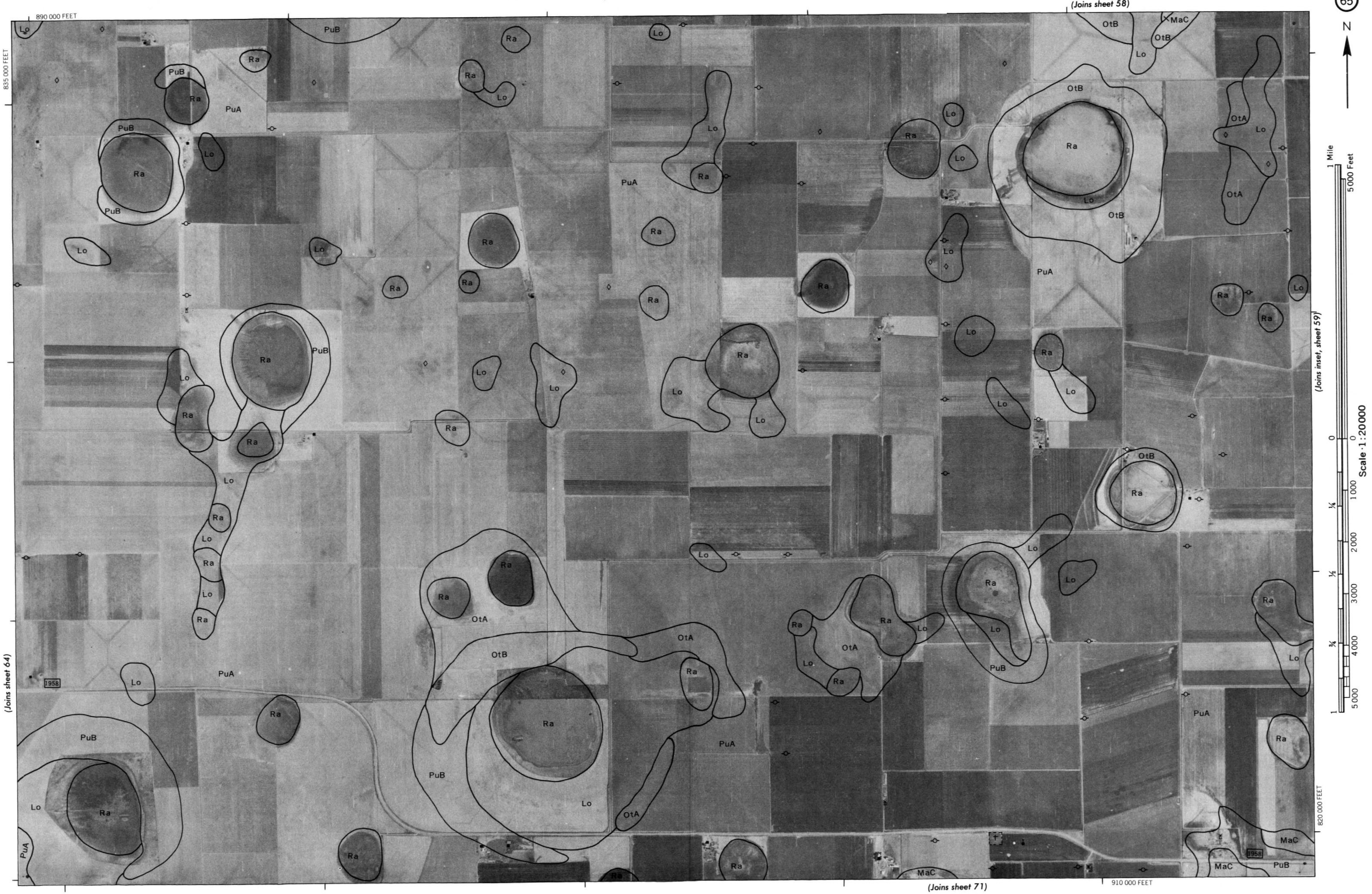

61
N
(Joins sheet 54)
(Joins sheet 62)
(Joins sheet 67)
(Joins sheet 60)
795 000 FEET
835 000 FEET
825 000 FEET
815 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
McCoy
3111
54
Ra
Lo
OtB
OtA
PuA
PuB
EsB
MaC
MaB

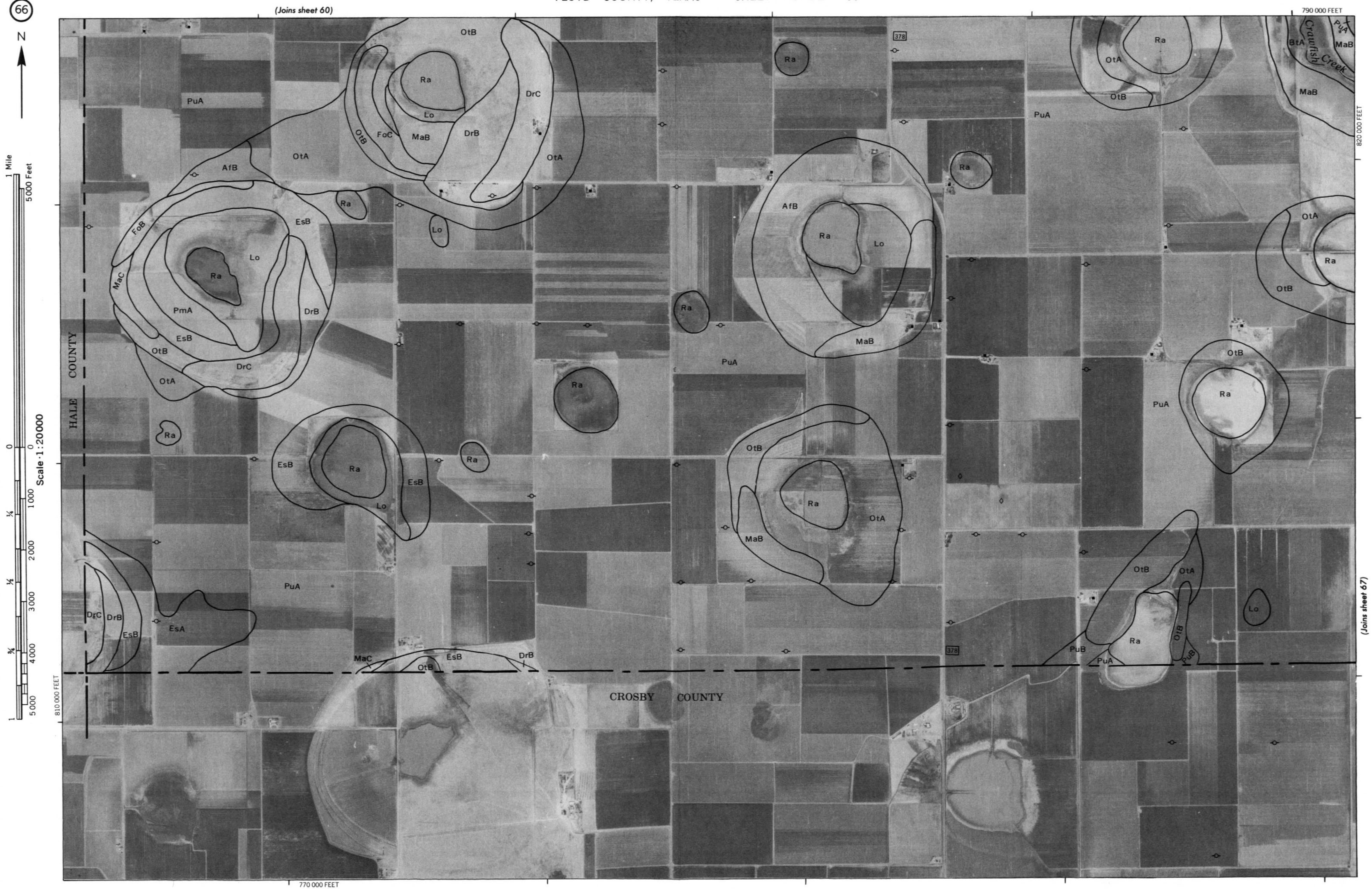
FLOYD COUNTY, TEXAS — SHEET NUMBER 62

# FLOYD COUNTY, TEXAS — SHEET NUMBER 63

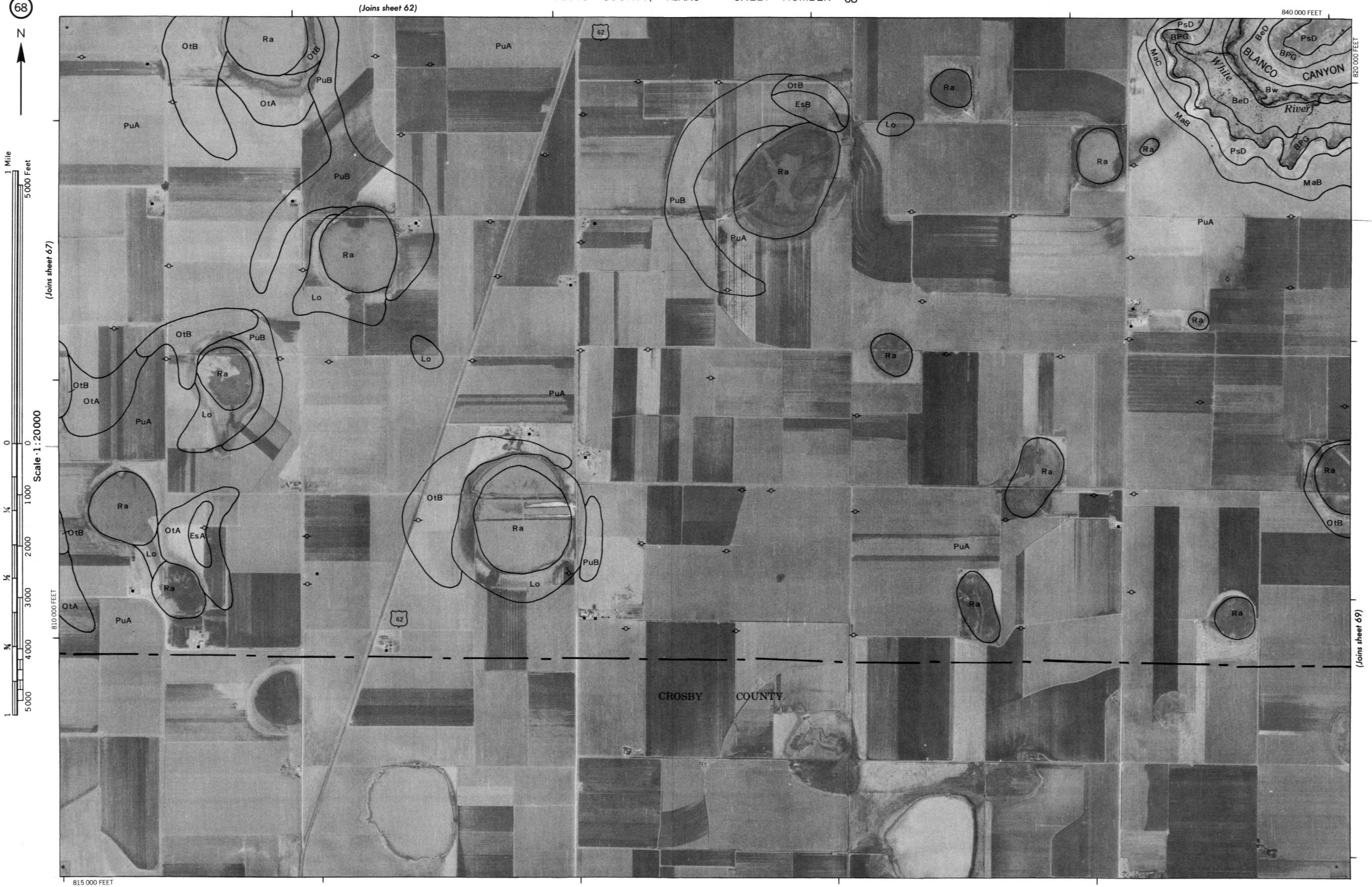



N
(Joins sheet 57)
885 000 FEET
835 000 FEET
(Joins sheet 63)
(Joins sheet 65)
825 000 FEET
865 000 FEET
(Joins sheet 70)
1958
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
1000
2000
3000
4000
5000
PuB
PuA
Lo
Ra
MaB
OtB
OtA
EsB
EsA
DrC

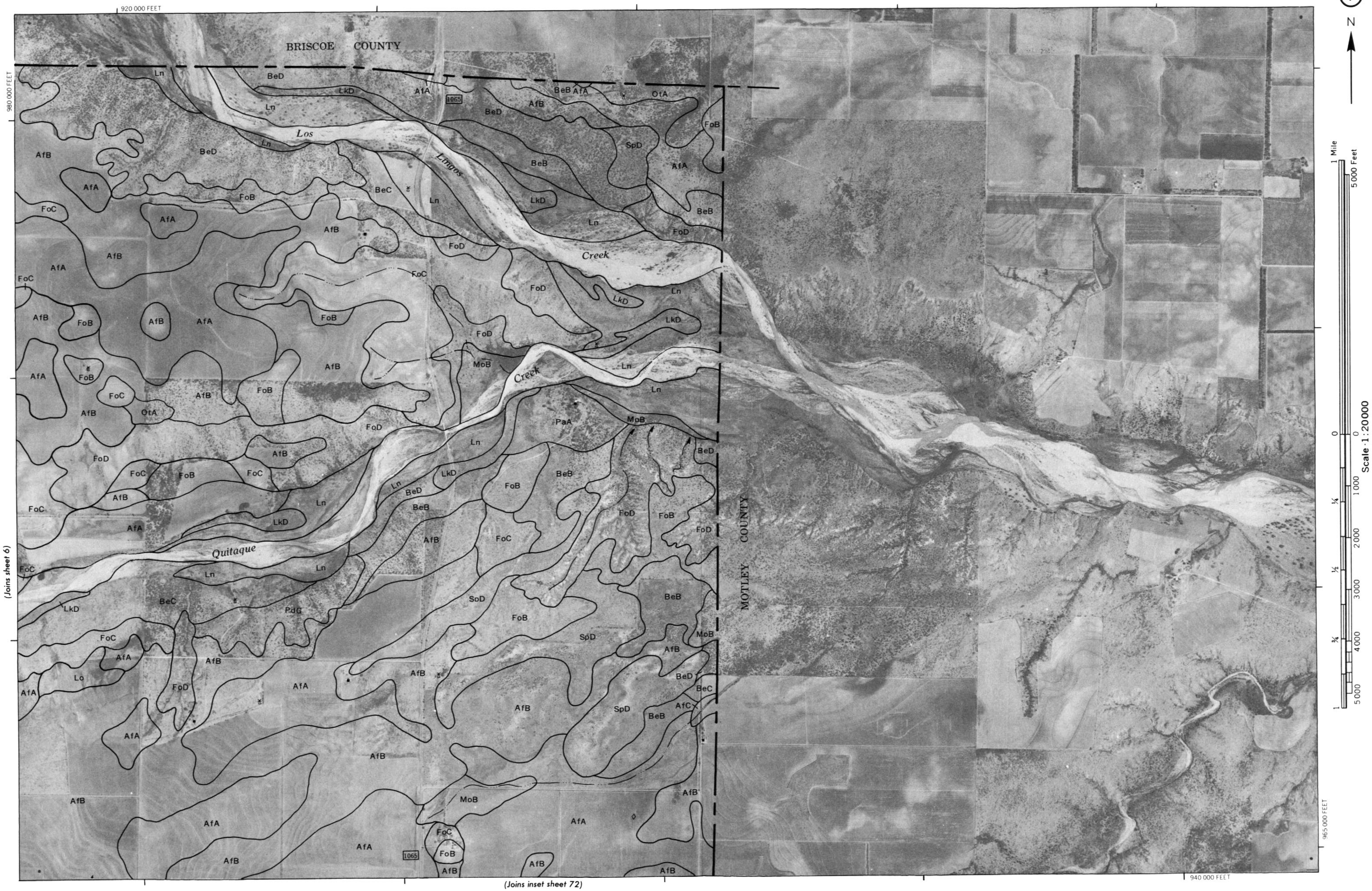

65
N
(Joins sheet 58)
890 000 FEET
835 000 FEET
(Joins inset, sheet 59)
(Joins sheet 64)
(Joins sheet 71)
910 000 FEET
820 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
1958

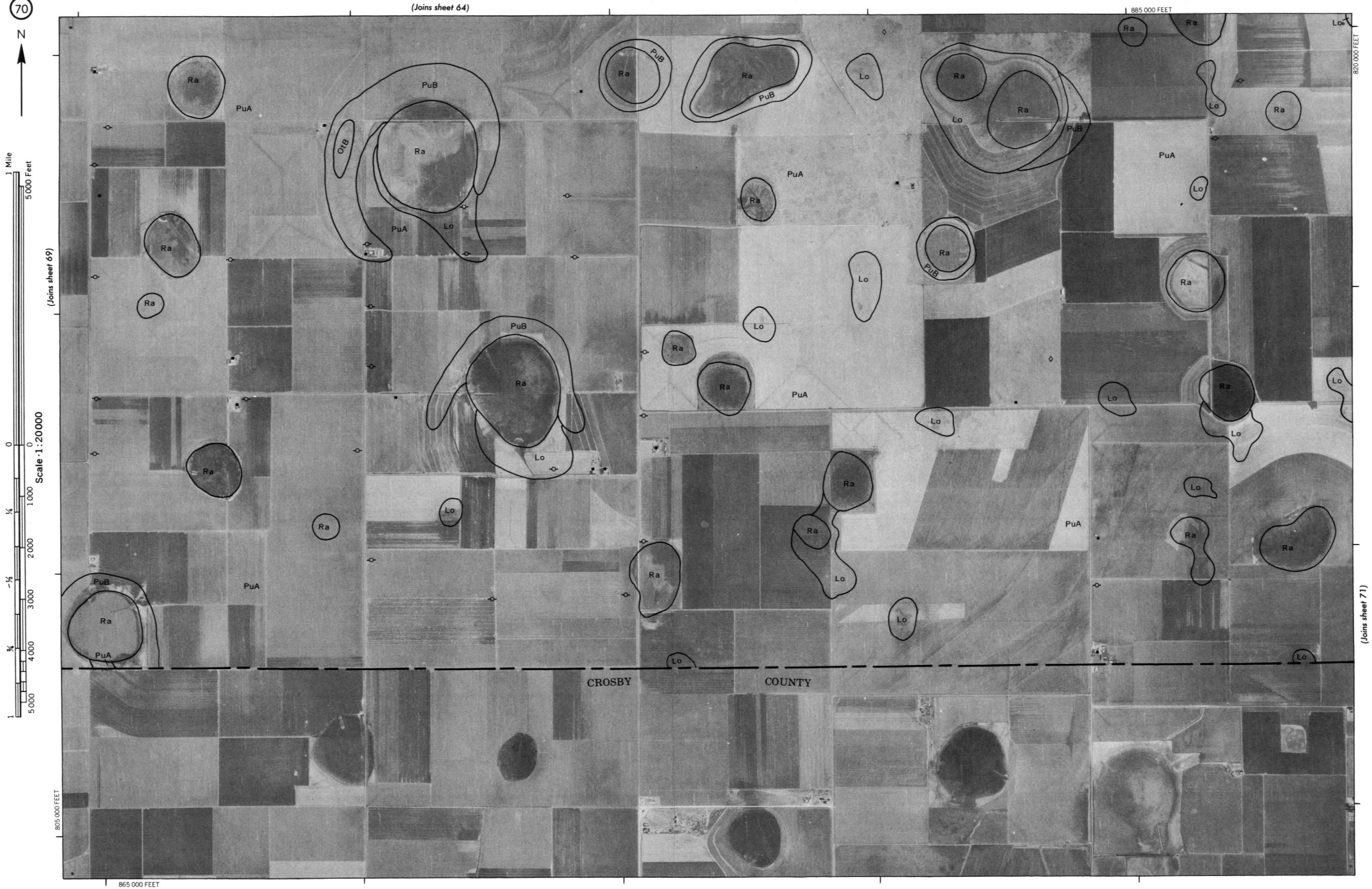

N
(Joins sheet 60)
790 000 FEET
820 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
0
¼
½
¾
1
810 000 FEET
770 000 FEET
(Joins sheet 67)
HALE COUNTY
CROSBY COUNTY
Crawfish Creek
378
OtB
Ra
DrC
Lo
OtB
FoC
MaB
DrB
OtA
AfB
PuA
FoB
EsB
MaC
Lo
Ra
PmA
DrB
EsB
OtB
DrC
OtA
Ra
Lo
Ra
Ra
EsB
Ra
EsB
Lo
Ra
DrC
DrB
EsB
EsA
PuA
MaC
OtB
EsB
DrB
Ra
Ra
AfB
Ra
Lo
MaB
PuA
OtB
Ra
OtA
MaB
OtA
OtB
Ra
BtA
MaB
PuA
MaB
OtA
Ra
OtB
OtB
Ra
PuA
OtB
OtA
Lo
Ra
OtB
PuB
PuA
PuB

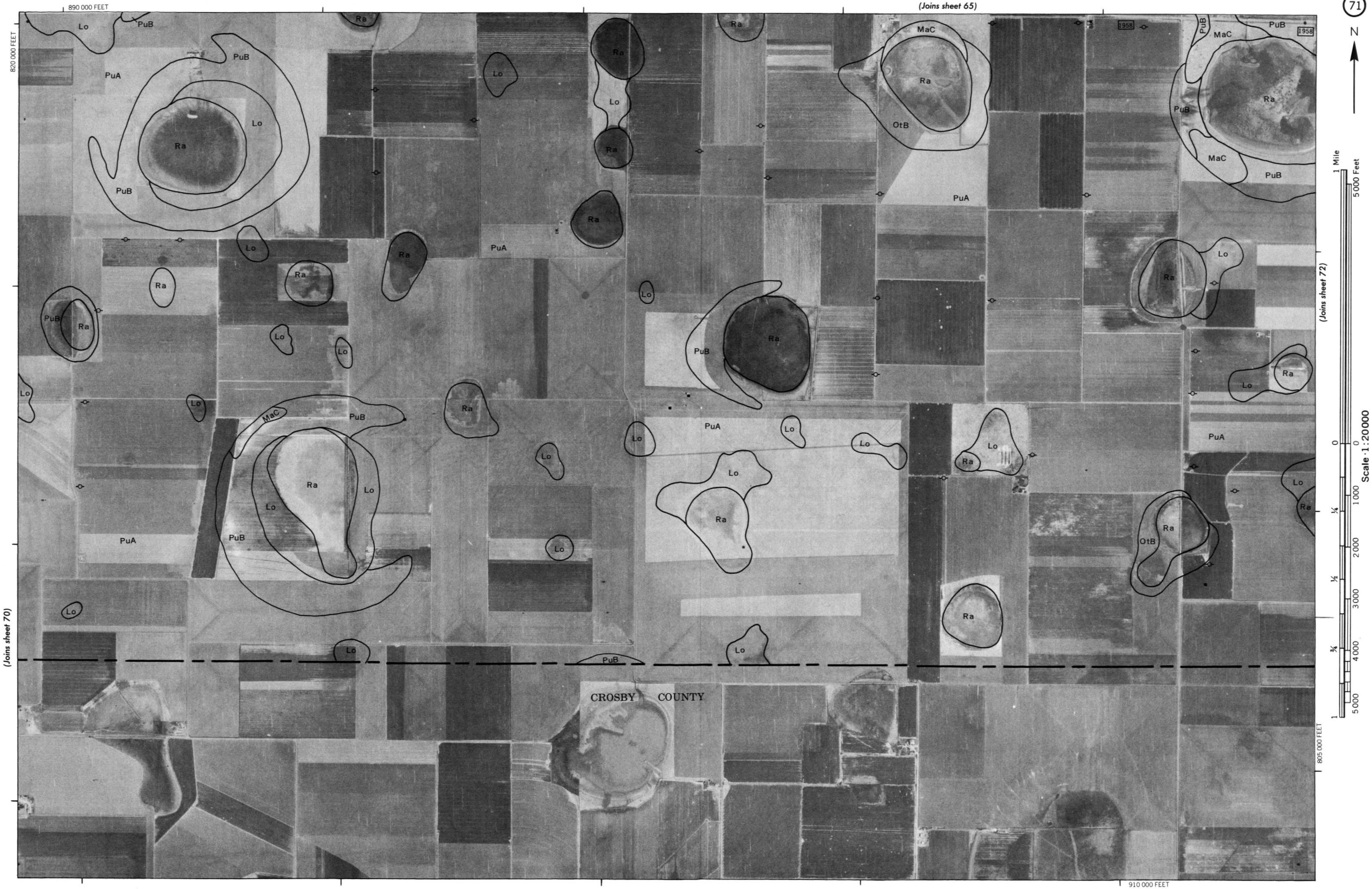

795 000 FEET
(Joins sheet 61)
67
N
820 000 FEET
(Joins sheet 68)
1 Mile
5 000 Feet
Scale 1:20000
810 000 FEET
(Joins sheet 66)
815 000 FEET
Crawfish
Creek
CROSBY COUNTY
PuA
PuB
BtA
MaB
MaC
OtA
OtB
Ra
Lo
EsB

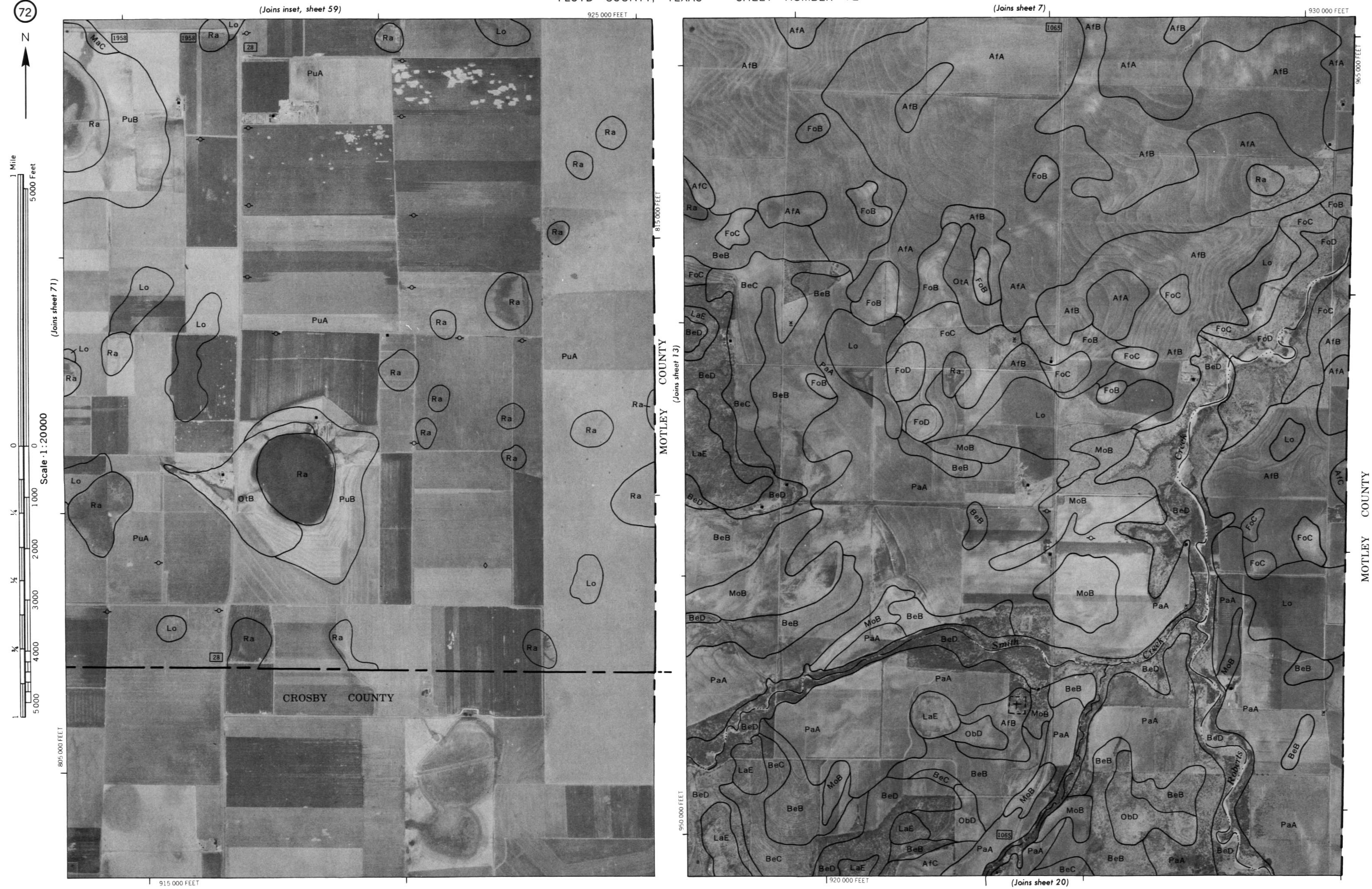

(Joins sheet 62)
(Joins sheet 67)
(Joins sheet 69)
840 000 FEET
820 000 FEET
810 000 FEET
815 000 FEET
N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
¼
½
¾
1
62
BLANCO CANYON
White River
CROSBY COUNTY
OtB
Ra
OtA
PuB
PuA
Lo
EsB
EsA
PsD
BPG
BeD
MaC
MaB
Bw


845 000 FEET
(Joins sheet 63)
820 000 FEET
(Joins sheet 68)
(Joins sheet 70)
805 000 FEET
860 000 FEET
N
1 Mile
5000 Feet
Scale 1:20000
White
River
BLANCO
CANYON
CROSBY COUNTY
651

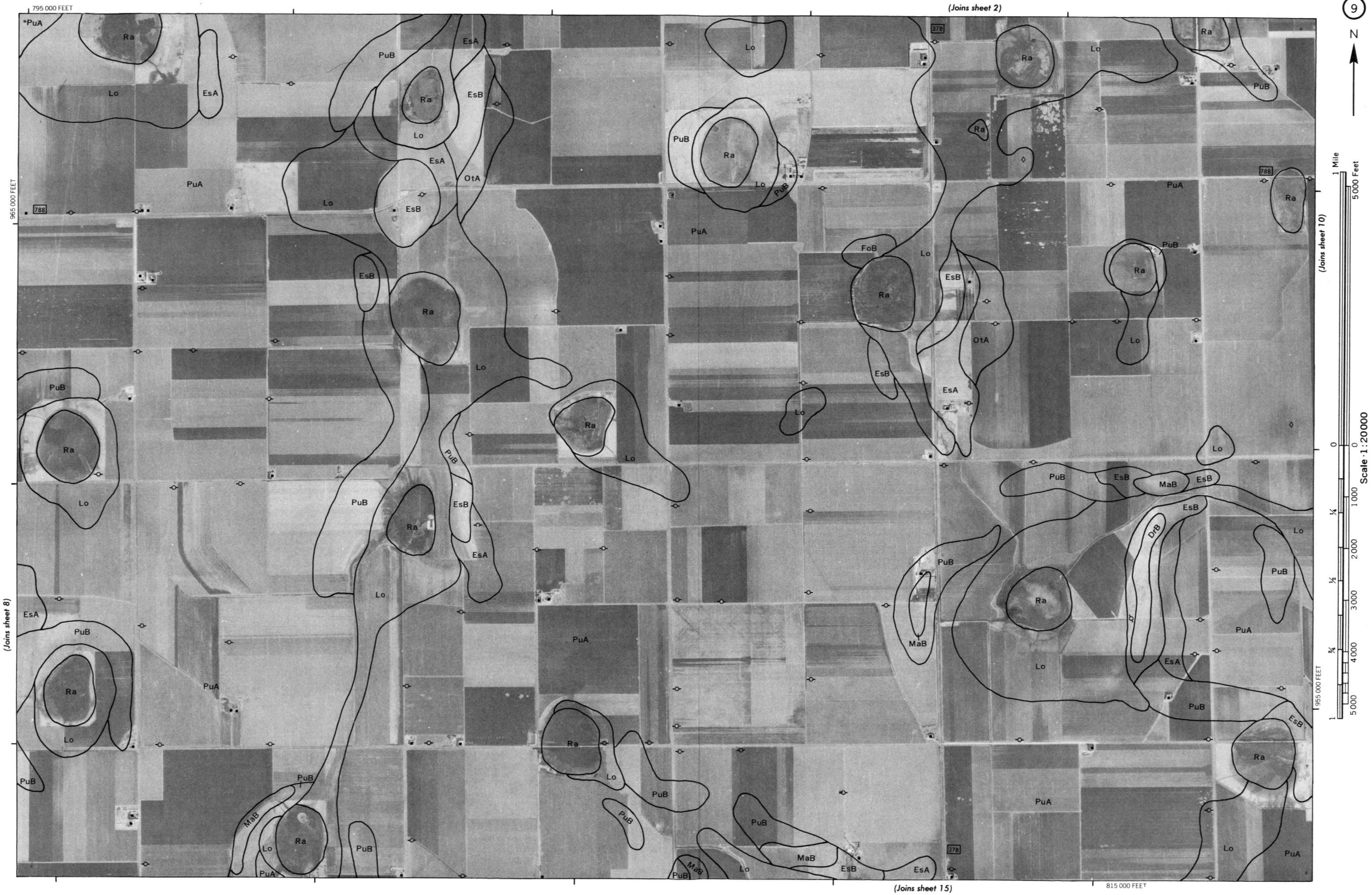

BRISCOE COUNTY
MOTLEY COUNTY
Los
Lingos
Creek
Quitaque
Creek
920 000 FEET
980 000 FEET
965 000 FEET
940 000 FEET
(Joins sheet 6)
(Joins inset sheet 72)
1065
N
1 Mile
5 000 Feet
Scale 1:20000
AfA
AfB
AfC
BeB
BeC
BeD
FoB
FoC
FoD
LkD
Ln
Lo
MoB
OtA
PaA
PdG
SoD
SpD


N
1 Mile
5 000 Feet
Scale 1:20000
(Joins sheet 64)
(Joins sheet 69)
(Joins sheet 71)
885 000 FEET
820 000 FEET
865 000 FEET
805 000 FEET
CROSBY
COUNTY
Ra
PuA
PuB
Lo
OtB


71
N
890 000 FEET
820 000 FEET
(Joins sheet 65)
(Joins sheet 72)
(Joins sheet 70)
805 000 FEET
910 000 FEET
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
1958
CROSBY
COUNTY
Lo
PuB
PuA
Ra
MaC
OtB


72
N
(Joins inset, sheet 59)
(Joins sheet 7)
(Joins sheet 71)
(Joins sheet 13)
(Joins sheet 20)
925 000 FEET
930 000 FEET
915 000 FEET
920 000 FEET
815 000 FEET
805 000 FEET
965 000 FEET
950 000 FEET
MOTLEY COUNTY
CROSBY COUNTY
Smith Creek
Roberts
Creek
1 Mile
5 000 Feet
Scale 1:20000
0
1/4
1/2
3/4
1000
2000
3000
4000
5000


8
N
(Joins sheet 1)
795 000 FEET
965 000 FEET
(Joins sheet 9)
955 000 FEET
770 000 FEET
(Joins sheet 14)
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
HALE
COUNTY
BROWNS
AIRSTRIP
Providence
788
2301
PuB
Lo
Ra
EsB
EsA
OtA
PuA
MaB
MaC
DrC
DrB


9
N
795 000 FEET
(Joins sheet 2)
(Joins sheet 10)
(Joins sheet 15)
(Joins sheet 8)
965 000 FEET
955 000 FEET
815 000 FEET
788
378
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
*PuA
Ra
Lo
EsA
PuB
EsB
OtA
PuA
FoB
DrB
MaB
EsA
Ra
Lo
PuB
MaB
Lo
PuA
EsB